

Where this unit fits in

This unit builds on:

unit 6B Microorganisms in the key stage 2 scheme of work and on unit 8B Respiration.

The concepts in this unit are:

characteristics of microorganisms, growing microbes to make products, the role of microorganisms in infectious diseases, the body's defence systems against microbial infections, immunisation, antiseptics and antibiotics.

This unit leads onto:

unit 9B Fit and healthy in which pupils have further opportunities to consider the transmission and incidence of infectious diseases. This unit lays the foundation for work in key stage 4 on the body's defences against infection and the uses of microorganisms in biotechnology.

Prior learning

To make good progress, pupils starting this unit need to know:

- that microorganisms are living things
- that microorganisms feed grow and reproduce like other organisms
- that organisms respire aerobically producing carbon dioxide
- the names of some diseases caused by microorganisms.

Framework yearly teaching objectives – Cells

- Classify bacteria and fungi as cellular microorganisms and viruses as microorganisms that are smaller than a cell; explain that some microorganisms are useful to humans and some are harmful.
- Describe some of the systems in the human body for fighting infecting microorganisms and immunisation as a way of improving immunity; use knowledge of cells, tissues and organs to explain how these systems work.

Expectations from the QCA Scheme of Work

At the end of this unit ...

... most pupils will ...

... some pupils will not have made so much progress and will ...

... some pupils will have progressed further and will ...

in terms of scientific enquiry NC Programme of Study Sc1 1b, c, 2c, f, g, i, j, k, l, m

- describe how understanding of how some infectious diseases are transmitted has developed as knowledge about microorganisms has increased
- point out trends and patterns in first-hand and secondary data, draw conclusions from these and relate them to scientific knowledge and understanding.

- describe how some infectious diseases are transmitted, point out some patterns in data and use these to draw conclusions.

- describe how scientists' interpretation of evidence has led to new ideas about the transmission of disease and to new drugs.

in terms of life processes and living things NC Programme of Study Sc2 2h, j, n; Sc3 2h

- classify bacteria, fungi and viruses as microorganisms, name some of the diseases they can cause and describe how they can be transmitted
- describe some of the defences the body has against disease and describe immunisation as a way of improving immunity
- recognise that antibiotics are effective against bacteria but not against viruses.

- name some infectious diseases and describe how they can be transmitted
- describe immunisation as a way of protecting against infectious disease.

- explain how immunisation can improve immunity and describe how antibiotics may be effective across a wide spectrum or against specific bacteria.

Suggested lesson allocation (see individual lesson planning guides)

Direct route →

C1 Going on growing	C2 Defence systems	C3 Killing bacteria	C4 Fighting infection	C5 The battle goes on	C6 Testing medicines – Think about correlation	
<i>Extra lessons (not in pupil book)</i>						
C1 Investigate: What affects how yeast grows?						Review and assess progress (distributed appropriately)

Misconceptions

'Viruses and bacteria are about the same size.' 'Antibiotics kill bacteria and viruses.' 'All bacteria cause disease.' Pupils sometimes have difficulty distinguishing between infectious diseases and other forms of illness.

Additional information

This unit can be linked into the school's PSHE programme.

Consult the school's sex education policy with regard to discussing AIDS

There will be a need for sensitivity to pupils and their families who may have had a particular illness, have had a particular illness or have reduced resistance to infection.

Health and safety (see activity notes to inform risk assessment)

Risk assessments are required for any hazardous activity. All work with microorganisms should only be carried out after full risk assessment.

Employer's or LEA risk assessments relating to work with culture plates should be followed. In this unit pupils might:

- plan and carry out an investigation with yeast
- grow lactobacilli to produce yoghurt. Yoghurt made for consumption should only be made in a food technology area.
- observe the growth of bacteria and the effects of antiseptics and antibiotics.

All cultures should be sealed. Mouldy food should be sealed in plastic bags, containers or Petri dishes so that the spores are not released.

School based training in aseptic techniques might be needed.

Learning objectives

- i There are three types of microorganism: bacteria, viruses and fungi.
- ii Many microorganisms are useful.

Scientific enquiry

- iii Grow microbes microorganisms safely.
- iv Use ICT to measure the activity of a microbe. (Framework Y10 Sc1 8d)

Suggested alternative starter activities (5–10 minutes)

Introduce the unit	Share learning objectives	Problem solving	Capture interest (1)	Capture interest (2)
Unit map for ecological relationships.	<ul style="list-style-type: none"> Find out about the different types of microorganisms. How microorganisms can be useful. Be able to grow microorganisms. (Sc1) 	Pupils divide the pictures into bacteria, fungi, viruses, and non-microorganisms.	Show a video clip of microorganisms growing on agar plate. <i>Catalyst Interactive Presentations 2</i>	Pupils decide if they would take a summer holiday job starting at 1p and doubling each day.

Suggested alternative main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C1	i and ii	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.	20 min	R/G	G	R	S
Activity C1a Practical	iii	Growing microorganisms Pupils grow yoghurt microorganisms on agar plates	15 min	✓			
Activity C1b Paper	iv	Divide and grow Extension activity about cell division in 24 hours	15 min			✓	

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Word game	Looking ahead
Do a 'What am I?' game for each type of microorganism.	Whole-class feedback on Activity C1a.	Groups of pupils discuss the outcome of calculations in Activity C1c.	In the 'Fast talker' game, pupils name as many things associated with microorganisms as they can.	Looking ahead to C2, pupils suggest how microorganisms can be problematic or even harmful.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> classify bacteria, fungi and viruses as microorganisms describe the features of bacteria, viruses and fungi describe some uses of bacteria. 	<ul style="list-style-type: none"> state some features of bacteria, viruses and fungi name some products made using fungi or bacteria. 	<ul style="list-style-type: none"> explain how bacteria and fungi reproduce by cell division.

Key words

microorganism, microbes, bacteria, fungi (*singular* fungus), viruses, *red only*: hyphae, micrometre

Out-of-lesson learning[Homework C1](#)

Textbook C1 end-of-spread questions

[Activity C1b](#)

Visit a microbiology lab, bakery or creamery.

Invite a food scientist or microbiologist in to school.

Use reference material to find out about growing bacteria or fungi to make a product, e.g. yoghurt or cheese

Investigate: What affects how yeast grows?

Learning objectives

- i Investigate the activity of yeast.

Scientific enquiry

- ii Consider the number of measurements needed for reliable data. (Framework Y10 Sc1 8g)
iii Identify and control relevant variables. (Framework Y10 Sc1 8e)

Suggested alternative starter activities (5–10 minutes)

Setting the context	Introduce the apparatus	Safety	Brainstorming (1)	Brainstorming (2)
Explain that yeast is a living organism and how it can be used to investigate living processes.	Show pupils the apparatus available for the investigation.	Pupils identify any hazards involved in the investigation.	Pupils brainstorm ideas about the different variables involved in the investigation.	Pupils brainstorm ideas about making it a fair test, how to make the results valid, and any preliminary work that needs to be done.

Investigation

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Activity C1c Practical	i, ii and iii	What affects how yeast grows? Pupils work in pairs to plan their investigations to investigate how increasing the quantity of sugar or the temperature affects the quantity of carbon dioxide produced. Resource 1 and Resource 2 to help less able pupils with planning and evaluating.	60 min	✓	✓		

Suggested alternative plenary activities (5–10 minutes)

Review learning	Group feedback	Analysing	Evaluating
Teacher-led review of the planning and carrying out of the investigation.	In groups, pupils discuss their findings.	Teacher-led review of the findings of the investigation.	Teacher-led review of how the method could be improved.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> evaluate methods proposed and agree a common approach identify the variables they need to control and work out how many measurements to take collect data and identify trends. 	<ul style="list-style-type: none"> plan a simple strategy that is a fair test collect data identify trends given help with recording and analysis. 	<ul style="list-style-type: none"> relate their results to prior knowledge and understanding of respiration.

Learning objectives

- i Some microorganisms can cause disease.
- ii Microorganisms enter the body in a range of ways.
- iii The body has natural barriers to infection.
- iv The immune system can fight off infection using white blood cells and antibodies.

Scientific enquiry

- v Recognise hazards when working with microorganisms.

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Capture interest (1)	Capture interest (2)
Pupils complete a crossword using key words from last lesson.	<ul style="list-style-type: none"> Find out how microorganisms cause disease. Find out about the body's defences. Be able to spot hazards involving microorganisms. (Sc1) 	Identify health hazards from a cartoon of a butcher's shop.	Video of different diseases around the world. <i>Catalyst Interactive Presentations 2</i>	Show an animation of white blood cells attacking bacteria. <i>Catalyst Interactive Presentations 2</i>

Suggested alternative main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C2	i, ii, iii and iv	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.	20 min	R/G	G	R	S
Activity C2a Paper	v	Natural defences Pupils match labels to a diagram of the body to show natural defence mechanisms.	15 min	✓			
Activity C2b Practical	iii	White blood cells Pupils look at white blood cells under a microscope.	15 min	✓			
Activity C2c <i>Catalyst Interactive Presentations 2</i>	v	Support version of Activity C2a as interactive animation.	10 min				✓

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Pupils differentiate between harmful and useful microorganisms.	Pupils use key words to describe how the body protects itself against disease.	Pupils feedback from butcher's shop cartoon.	Pupils brainstorm how to avoid infection from a disease.	Pupils suggest various ways of killing harmful microorganisms.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> name some of the diseases they can cause and describe how they can be transmitted describe some of the defences the body has against disease explain the role of the white blood cells produce a leaflet giving advice on avoiding infection. 	<ul style="list-style-type: none"> name some infectious diseases and describe how they can be transmitted recognise that white cells produce antibodies to fight microorganisms. 	<ul style="list-style-type: none"> classify a range of diseases caused by bacteria, fungi and viruses discuss how AIDS stops the immune system working.

Key words

sexually transmitted diseases, immune system, white blood cells, antibodies, immune, infections, pathogens

Out-of-lesson learning

[Homework C2](#)
Textbook C2 end-of-spread questions
[Activity C2a](#)

Learning objectives

- i Antiseptics contain substances that kill bacteria.
- ii Some medicines contain antibiotics that kill bacteria or prevent their growth, but they have no effect on viruses.

Scientific enquiry

- iii Scientific advances may depend on creative thought and interpretation of evidence. (Framework YTO Sc1 8a)
- iv Recognise hazards when working with microorganisms.

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Brainstorming	Capture interest
Play the 'Tip of my tongue' game using keywords from last lesson.	<ul style="list-style-type: none"> Find out about antiseptics and antibiotics. Be able to spot hazards involving microorganisms. (Sc1) 	Pupils identify the hazards of working with microorganisms.	Pupils brainstorm a list of products that they have seen advertised to treat common infections.	Pupils answer multiple-choice 'Did you know?' questions.

Suggested alternative main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C3	i, ii and iii	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.	20 min	R/G	G	R	S
Activity C3a Practical	i and iv	Killing microorganisms Pupils observe the effect of household products and antibiotics on bacteria.	15 min	✓			
Activity C3b Discussion	ii	A visit to the doctor Role play of person going to doctors for some tablets to treat a cold.	20 min	✓			

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Check progress by adding new key words to Unit map.	Whole-class feedback on Activity C3a.	Pupils feedback on Activity C3b.	Pupils identify the creativity in terms of interpreting the evidence in the story of Alexander Fleming.	Ask pupils what they know about MMR and write the list on the board.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> describe immunisation as a way of improving immunity recognise that antibiotics are effective against bacteria but not against viruses show in their writing that scientific advance may come from creative thought and interpretation of evidence. 	<ul style="list-style-type: none"> describe immunisation as a way of protecting against infectious disease state the difference between an antiseptic and an antibiotic 	<ul style="list-style-type: none"> explain how immunisation can improve immunity and describe how antibiotics may be effective across a wide spectrum or against specific bacteria discuss the development of antiviral drugs explain trends in polio/diphtheria data since the introduction of the vaccine.

Key words

antiseptics, antibiotic, agar plate, *red only*: penicillin, broad-spectrum antibiotics, narrow-spectrum antibiotics, antivirals

Out-of-lesson learning

[Homework C3](#)
Textbook C3 end-of-spread questions

Learning objectives

- i The immune system can be helped by vaccination.

Scientific enquiry

- ii Scientific advances may depend on creative thought and interpretation of evidence. (Framework YTO Sc1 8a)
 iii Recognise hazards when working with microorganisms.
 iv Analyse data on measles (*red only*). (Framework YTO Sc1 8d)

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Brainstorming	Capture interest
Wordsearch using words from last lesson.	<ul style="list-style-type: none"> Find out about vaccination. Be able to explain that scientific advances depend on creative thought and interpreting evidence. (Sc1) 	Pupils discuss the pros and cons for the MMR vaccination and decide whether to vaccinate or not.	Pupils brainstorm ideas for protecting themselves from disease when going on holiday abroad, in preparation for Activity C4a.	Quiz on how long vaccinations last?

Suggested alternative main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C4	i, ii and iii	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.	20 min	R/G	G	R	S
Activity C4a Paper	i	Foreign places Pupils use information about how you can protect yourself from diseases when going on holiday by having vaccinations and answer questions	10 min	✓			
Activity C4b ICT	ii	Discovering microorganisms Pupils look at the work of Jenner, Lister and Fleming and present information to an audience.	20 min	✓			
Activity C4c Paper	iv	Fighting measles Pupils interpret a graph about the incidences of measles since vaccination was introduced.	10 min			✓	

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Word game	Looking ahead
Check progress by completing the Unit map using new words.	Whole-class feedback on Activity C4a.	Pupils review each other's presentations from Activity C4b.	Quick 'Millionaire game' based on material in unit so far.	Pupils suggest what we would do and how it would affect our lives if a major new disease struck the UK.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> describe immunisation as a way of improving immunity recognise that antibiotics are effective against bacteria but not against viruses show in their writing that scientific advance may come from creative thought and interpretation of evidence. 	<ul style="list-style-type: none"> describe immunisation as a way of protecting against infectious disease state the difference between an antiseptic and an antibiotic. 	<ul style="list-style-type: none"> explain how immunisation can improve immunity and describe how antibiotics may be effective across a wide spectrum or against specific bacteria discuss the development of antiviral drugs explain trends in polio/diphtheria data since the introduction of the vaccine.

Key words

vaccination, immunised, *red only*: active and passive immunity, vaccinated, inoculation

Out-of-lesson learning

[Homework C4](#)
 Textbook C4 end-of-spread questions
[Activity C4c](#)

Learning objectives

- i Ways that people prevented the spread of disease before the role of microorganisms was known.
- ii How the incidence of a disease has changed over a period of time.

Scientific enquiry

- iii How a theory can be used to make predictions which can be tested by collecting evidence. (Framework Y10 Sc1 8a)
- iv How scientists today tackle the spread of infectious disease.

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving (1)	Capture interest (1)	Capture interest (2)
Play the 'Who am I?' game.	<ul style="list-style-type: none"> Find out about how people stopped the spread of disease before microorganisms were discovered. Find out about modern day methods. Be able to explain how a theory can be tested by collecting evidence. (Sc1) 	Using SARS as an example, give examples of causes of disease and ask students how they would test to find out which was the correct cause (just to show how difficult it is). Beware – pupils could raise the issue of testing on live animals.	Show a video clip of people in China wearing face masks during the SARS outbreak. <i>Catalyst Interactive Presentations 2</i>	Introduce the idea of placebos by asking 'Does colour affect how good a medicine is?'

Suggested alternative main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C5	i, ii, iii and iv	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.	20 min	R/G	G	R	S
Activity C5a Discussion	i	Escape from Eyam or not? Pupils decide what they would have done in the villagers place.	15 min	✓			
Activity C5b ICT	ii	Avoiding outbreaks Presentation/poster about causes and solutions to modern-day epidemic outbreaks	15 min	✓			

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Word search on modern control methods, chlorination, boiling, immunisation, antibiotics.	One pupil from each group feeds back what they would have done in Activity C5a.	Pupils share the results of their Internet search in Activity C5b.	Pupils suggest what difficulties scientists might have finding new medicines and how they might go about doing it.	Pupils revise and consolidate knowledge from the unit.

Learning outcomes

Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> present information about how the villagers of Eyam contained the plague compare how scientists have tackled the spread of disease in different ways describe how modern discoveries have improved methods of avoiding infection. 	<ul style="list-style-type: none"> with help present information about a method of avoiding infection describe how a scientist tackled the spread of disease (plague or cholera) in the past. state how the spread of this disease is controlled now. 	<ul style="list-style-type: none"> discuss Carlos Finley's work and how it has helped to control the spread of Yellow fever.

Key words
red only: epidemic

Out-of-lesson learning
[Homework C5](#)
Textbook C5 end-of-spread questions

Testing medicines – Think about correlation in testing new medicines

Learning objectives

i How medicines are tested, including placebos.

The structure of this lesson is based around the CASE approach. The starter activities give concrete preparation. The main activities move away from the concrete towards a challenging situation, where pupils need to think. The extended plenary gives pupils time to discuss what they have learnt, to negotiate a method to commit to paper and express their ideas verbally to the rest of the class.

Scientific enquiry

ii Correlation.

iii Double blind tests (*red only*).

Suggested alternative starter activities (5–10 minutes)

Bridging to the unit	Setting the context	Concrete preparation (1)
Pupils discuss what colour tablet they think works best.	Introduce the use of placebos.	Brainstorm ideas to test the hypothesis that purple tablets are more effective than white ones.

Suggested main activities

Activity	Learning objective see above	Description	Approx. timing	Target group			
				C	H	E	S
Textbook C6	i, ii and iii	Teacher-led explanation and questioning <i>OR</i> pupils work individually, in pairs or in small groups, through the in-text questions and then onto the end-of-spread questions if time allows.	30 min	R/G	G	R	S
Activity C6a Paper	ii	Undiscovered antibiotics Pupils make and revise their hypotheses about the source of an unknown antibiotic.	20 min	✓			

Suggested alternative plenary activities (5–10 minutes)

Group feedback	Bridging to other topics
Pupils discuss the implications of jumping to conclusions and hypothesis testing.	The idea of the structure of the solar system.

Learning outcomes

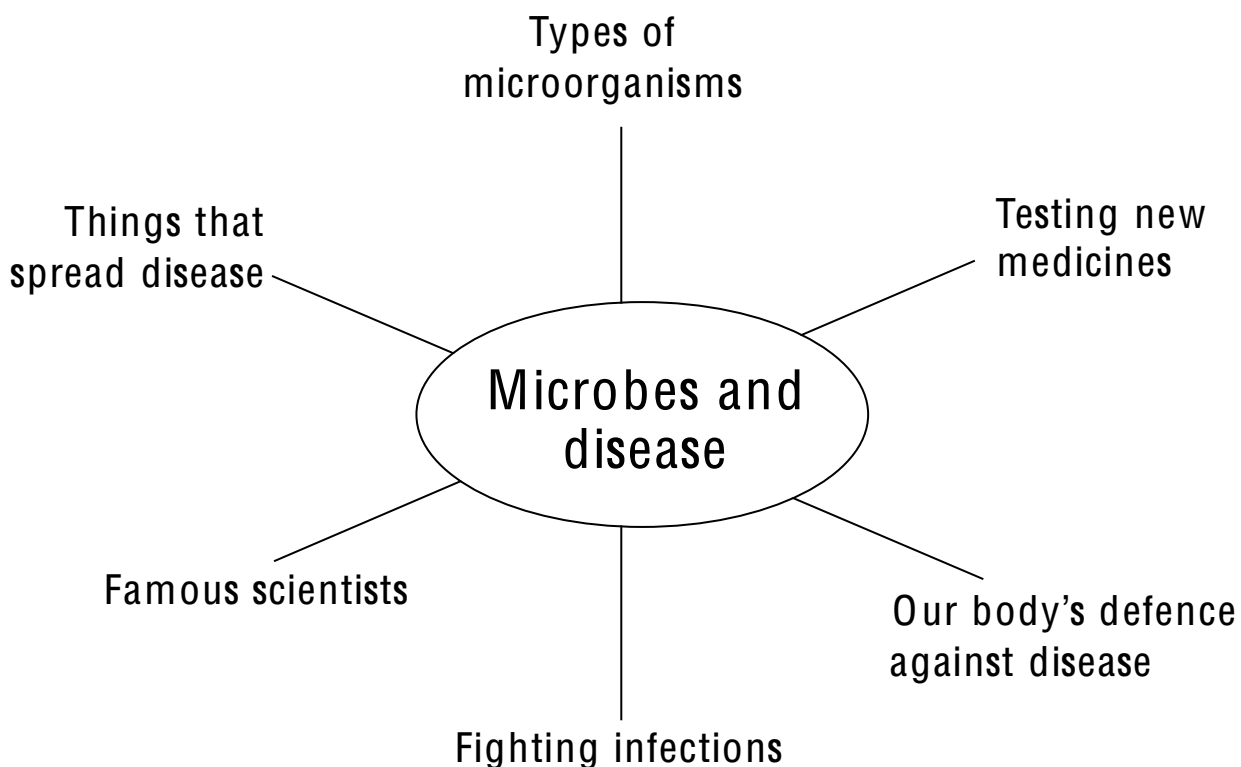
Most pupils will ...	Some pupils, making less progress will ...	Some pupils, making more progress will ...
<ul style="list-style-type: none"> recognise that new medicines have to be tested on animals first and then on human volunteers to make sure they are safe. discuss the concept of a placebo analyse the results of a clinical trial for a drug and decide what type of correlation there is. use their analysis to decide whether the drug is beneficial or not 	<ul style="list-style-type: none"> discuss how new drugs are tested including the use of placebos. with help analyse the results of a clinical trial for a drug and decide what type of correlation there is. 	<ul style="list-style-type: none"> resolve cognitive conflict arising when the results of two trials are different from one another.

Key words

control, placebo, positive correlation, negative correlation, *red only*: double blind trial

Out-of-lesson learning

Textbook C6 end-of-spread questions



Copy the unit map and use these words to help you complete it.
You may add words of your own too.

antibiotic
antiseptic
bacteria
cholera
disinfectant
Finley
Fleming
fungi
harmful
immunisation
influenza
Jenner

mosquitoes
penicillin mould
rats
skin
smallpox
Snow
stomach acid
useful
vaccination
virus
white blood cells
yeast

Suggested alternative starter activities (5–10 minutes)

Introduce the unit	Share learning objectives	Problem solving	Capture interest (1)	Capture interest (2)
Unit map for ecological relationships.	<ul style="list-style-type: none"> Find out about the different types of microorganisms. How microorganisms can be useful. Be able to grow microorganisms. (Sc1) 	Pupils divide the pictures into bacteria, fungi, viruses, and non-microorganisms.	Show a video clip of microorganisms growing on agar plate. <i>Catalyst Interactive Presentations 2</i>	Pupils decide if they would take a summer holiday job starting at 1p and doubling each day.

Introduce the unit

- Either draw the outline of the unit map on the board then ask pupils to give you words to add, saying where to add them. Suggest some words yourself when necessary to keep pupils on the right track.
- Or give out the unit map and ask pupils to work in groups deciding how to add the listed words to the diagram. Then go through it on the board as each group gives suggestions.

→ [Unit map](#)**Share learning objectives**

- Ask pupils to write a list of FAQs they would put on a website telling people about organs, cells and tissues. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils look at a series of pictures of different organisms and sort them into different groups. Some pupils may need some help and should be allowed to refer to the textbook. The purpose of the activity is to show that different kinds of microorganisms exist and can be grouped into fungi, bacteria and viruses. This is an awareness-raising activity and not all pupils are expected to get all the right answers.

→ [Pupil sheet](#)

Answers

bacteria: 4 and 7; fungi: 2 and 5; viruses: 1 and 8; non-microorganisms: 3 and 6

Capture interest (1)

- Show a speeded-up video of microorganisms growing. Discuss with them the time actually taken for the growth shown.

→ [Catalyst Interactive Presentations 2](#)**Capture interest (2)**

- Pupils are asked if they would accept the offer of a summer holiday job. The conditions of acceptance are that they work for six weeks, work weekends as well as week days and are paid 1p for the first day's work, 2p for the second day's work, 4p for the third day's work, i.e. the wage doubles every day.
- Most pupils will refuse the offer of the job but you can show that if they had accepted, they would earn over one million pounds on day 28 and thousands of millions of pounds over the six weeks. The purpose of the exercise is to show that starting with just a single bacterium that doubles every 30 minutes, there are soon millions of them.

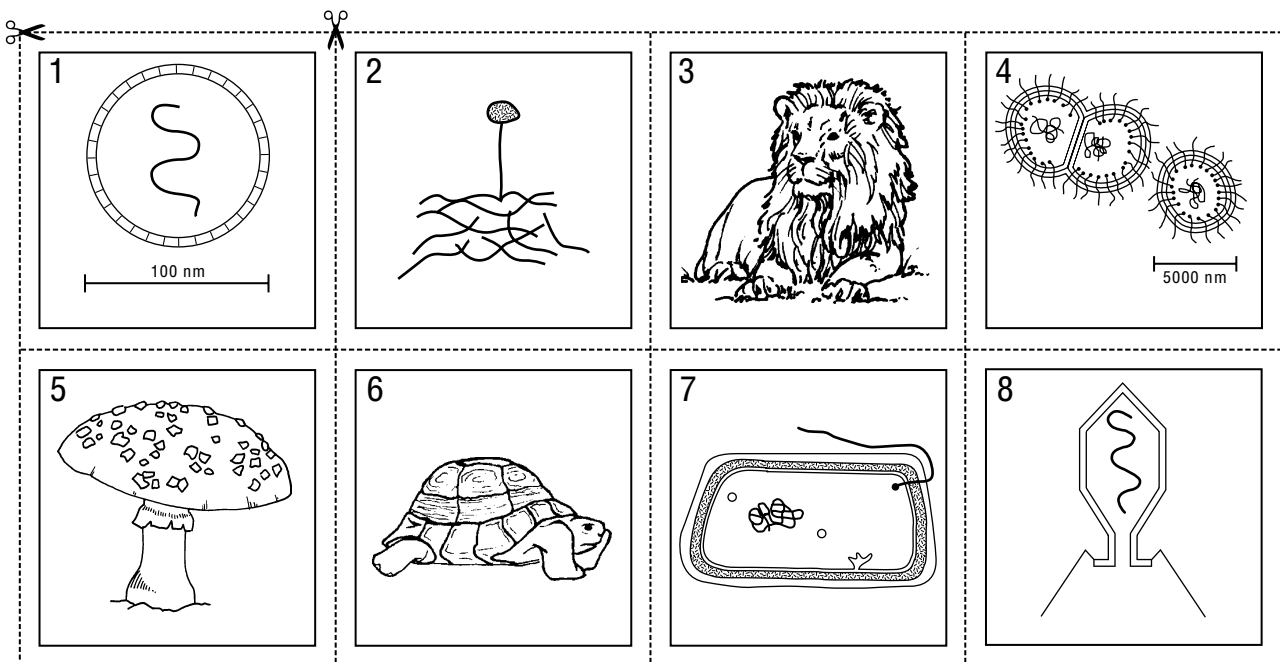
→ [Catalyst Interactive Presentations 2](#)

Problem solving

Look at the pictures below. They are of different kinds of living things.

Some of them are microorganisms (bacteria, fungi and viruses) and some are not.

Cut out each picture and then place them under one of the following headings: bacteria, fungi, viruses and non-microorganisms.



1 nm = 1 millionth of
a mm

Investigate: What affects how yeast grows?

Suggested alternative starter activities (5–10 minutes)

Setting the context	Introduce the apparatus	Safety	Brainstorming (1)	Brainstorming (2)
Explain that yeast is a living organism and how it can be used to investigate living processes.	Show pupils the apparatus available for the investigation.	Pupils identify any hazards involved in the investigation.	Pupils brainstorm ideas about the different variables involved in the investigation.	Pupils brainstorm ideas about making it a fair test, how to make the results valid, and any preliminary work that needs to be done.

Setting the context

- Ethical constraints often prevent us from investigating living processes. Pupils could be asked if they would be happy bringing in their pet dog or cat for other pupils to experiment on. However, there are no ethical constraints with yeast and we can use it to investigate a variety of living processes.

Introduce the apparatus

- Show pupils the apparatus available.
- Take suggestions from the class as to the role of each piece of equipment in the investigation. In particular, you might need to explain how the balloons are to be used.

Safety

- Ask pupils to work in pairs listing the hazards involved in this investigation.
- Pupils then decide how to minimise the danger presented by each hazard.
- Pairs report back to a class discussion during which a final set of safety procedures is listed on the board.

Brainstorming (1)

- Ask pupils to discuss in groups what the variables are in the investigation.
- Ask them to decide what variable should be changed (input variable) and what should be measured during the investigation (outcome variable).
- Ask individual pupils for their ideas. Use class discussion to finalise details of the two dependent variables.

Brainstorming (2)

- Ask pupils to work in groups to consider the questions opposite.
- Use answers from individual pupils to initiate class discussion about fair testing and reliability of results.

Questions

What needs to be done to make this a fair test?

Will the experiments need to be repeated?
Why?

Will a preliminary investigation be needed?
Why?

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Capture interest (1)	Capture interest (2)
Pupils complete a crossword using key words from last lesson.	<ul style="list-style-type: none"> Find out how microorganisms cause disease. Find out about the body's defences. Be able to spot hazards involving microorganisms. (Sc1) 	Identify health hazards from a cartoon of a butcher's shop.	Video of different diseases around the world. <i>Catalyst Interactive Presentations 2</i>	Show video clips of white blood cells attacking bacteria. <i>Catalyst Interactive Presentations 2</i>

Recap last lesson

- Pupils complete the crossword to remind themselves of the key words from last lesson.

→ [Pupil sheet](#)

Answers

1 bacteria; **2** agar; **3** colony; **4** fungi;
5 viruses; **6** microorganism; **7** sterile

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about how our body protects us against disease. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Give pupils the cartoon of a butcher's shop. They work in pairs for ten minutes to identify as many health hazards as they can.
- Explain that the feedback will be taking in the plenary at the end of the lesson.

→ [Pupil sheet](#)

Capture interest (1)

- Video of different diseases around the world. Some pupils may be squeamish and should be told not to watch.

→ *Catalyst Interactive Presentations 2*

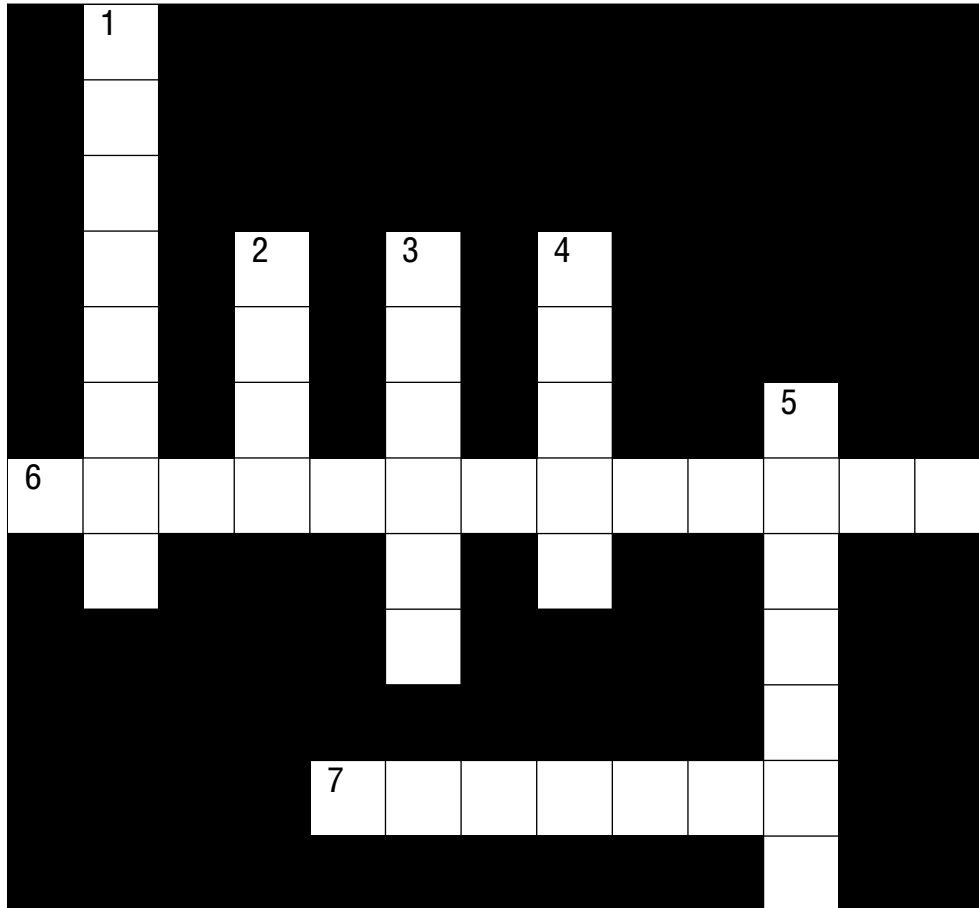
Capture interest (2)

- Show a video clip of white blood cells attacking and invading microorganisms.
- Ask the pupils to describe what they see.

→ *Catalyst Interactive Presentations 2*

Recap last lesson

Complete the crossword using the clues.



Across

- 6** The name for very small organisms.
7 A word that means no microorganisms are present.

Down

- 1** Microorganisms that can be seen under a microscope and can be used for making yoghurt.
2 A substance that microorganisms can be grown on.
3 A group of microorganisms.
4 Yeast belongs to this groups of microorganisms.
5 These microorganisms are so small that they cannot even be seen using a microscope.

Problem solving

Look carefully at the cartoon of the butcher's shop.

Working with your partner, find as many health hazards as you can.

It might help you to copy and complete this table.

Health hazard	Why it is a health hazard	What should be done



Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Brainstorming	Capture interest
Play the 'Tip of my tongue' game using key words from last lesson.	<ul style="list-style-type: none"> Find out about antiseptics and antibiotics. Be able to spot hazards involving microorganisms. (Sc1) 	Pupils identify the hazards of working with microorganisms.	Pupils brainstorm a list of products that they have seen advertised to treat common infections.	Pupils answer multiple-choice 'Did you know?' questions.

Recap last lesson

- Play 'Tip of my tongue' game. Describe the key words from last lesson and pupils identify the word from a description given.

Words

immune system, white blood cells, antibodies, sexually transmitted disease, immune.

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about how we can protect ourselves from disease. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils match the different hazards that can occur when working with microorganisms to the correct picture. Then they write down why each situation is dangerous.

→ [Pupil sheet](#)

Answers

A4 ... bacteria could be transferred to the Petri dish where they would grow to large numbers.

B3 ... dangerous bacteria could be transferred to the work bench.

C1 ... it allows bacteria to land on the agar and multiply to dangerous levels.

D2 ... the lid could be accidentally removed after the bacteria had been grown allowing the pupil to be contaminated with potentially dangerous bacteria.

Brainstorming

- Pupils brainstorm a list of all the products that they have seen advertised for treating colds, flu and minor infections. One pupil could write the list on the board at the front of the class.

Capture interest

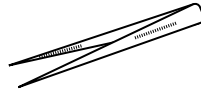
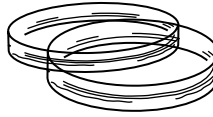
- Pupils answer the multiple-choice quiz questions by jotting down the letter for the answer.
- Go through each question and answer with the class, asking for a show of hands for each possible answer so you can see how much pupils know already.

→ [Pupil sheet](#)

Answers

1 C; **2** B; **3** C; **4** B

Problem solving

A**B****C****D**

Complete, then cut out the following labels. Match the labels to the above diagrams by sticking them into the boxes.

**1**

Lid left off Petri dish.

This is dangerous because

**2**

Lid not secured onto Petri dish.

This is dangerous because

3

Forceps left on bench after touching microorganism in a Petri dish.

This is dangerous because

4

Pupil touching the surface of the agar jelly with their fingers.

This is dangerous because

Capture interest

- 1 How long does it take to develop a new antibiotic?
A 1 year
B 5 years
C 15 years
- 2 How much does it cost to develop a new antibiotic?
A £10 million
B £150 million
C £1000 million
- 3 How many different chemicals are looked at, to choose one of them to become a new antibiotic?
A 10 000
B 50 000
C 100 000
- 4 How long does it take the drug company, to get a licence to sell a new antibiotic?
A 6 months
B 2 years
C 5 years

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This worksheet may have been altered from the original on the CD-ROM.

Sheet 1 of 1

Capture interest

- 1 How long does it take to develop a new antibiotic?
A 1 year
B 5 years
C 15 years
- 2 How much does it cost to develop a new antibiotic?
A £10 million
B £150 million
C £1000 million
- 3 How many different chemicals are looked at, to choose one of them to become a new antibiotic?
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Sheet 1 of 1

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving	Brainstorming	Capture interest
Wordsearch using words from last lesson.	<ul style="list-style-type: none"> Find out about vaccination. Be able to explain that scientific advances depend on creative thought and interpreting evidence. (Sc1) 	Pupils discuss the pros and cons for the MMR vaccination and decide whether to vaccinate or not.	Pupils brainstorm ideas for protecting themselves from disease when going on holiday abroad, in preparation for Activity C4a.	Quiz on how long vaccinations last?

Recap last lesson

- Pupils complete the wordsearch on the pupil sheet.
- Ring the words on a copy of the pupil sheet and show it as an OHT for them to check their answers. Use the words on it to introduce the lesson.

→ [Pupil sheet](#)

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about how we can protect ourselves from disease. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils are divided into two different groups. Each group chooses a speaker.
Red group are parents of a child suffering from autism.
Green group are doctors who want to persuade parents of the advantages of vaccinating their children with the MMR vaccine.
- Pupils read the arguments on the pupil sheet and decide which ones reflect the views of their group and why they think that. They also decide whether children should be vaccinated.
- Ask a speaker from each group to say what they decided and why. You could take a class vote.

→ [Pupil sheet](#)

Brainstorming

- Pupils brainstorm ideas about how to protect themselves from disease when going on holiday abroad. Ideas could include, vaccinations, drinking bottled water, mosquito nets, etc.

Capture interest

- Working in groups, pupils say how long they think a vaccination gives them protection against a specific disease.
- Go over the answers with them and suggest why some last for longer than others.

→ [Pupil sheet](#)

Answers

Rubella (German measles) – permanent.
Hepatitis – up to 20 years.
Flu – one to three years.
Tetanus – 10 years.

Recap last lesson

All the words below are connected with fighting infection. See how many of them you can find in the wordsearch.

Jenner

Lister

Snow

smallpox

cholera

antiseptic

vaccination

hypothesis

S	M	A	L	L	P	O	X	S	E	V
N	A	R	U	I	Q	A	J	G	A	U
F	M	E	P	S	R	N	C	C	Q	M
F	Z	L	B	T	E	T	C	H	Z	W
N	T	O	G	E	N	I	I	E	Y	G
S	E	H	D	R	N	S	H	H	J	A
E	G	C	L	A	E	E	S	K	F	J
O	Q	M	T	B	J	P	N	N	D	W
P	S	I	S	E	H	T	O	P	Y	H
Y	O	C	H	X	R	I	W	L	O	K
N	D	R	O	K	V	C	L	M	P	I

Capture interest

You may remember as a child being given a vaccination. Some vaccinations only last for a certain amount of time and then you have to have an extra dose, called a booster.

In your group discuss how long you think a vaccination gives you protection against each disease listed.

- A Rubella (German measles)
- B Hepatitis
- C Flu
- D Tetanus

Capture interest

You may remember as a child being given a vaccination. Some vaccinations only last for a certain amount of time and then you have to have an extra dose, called a booster.

In your group discuss how long you think a vaccination gives you protection against each disease listed.

- A Rubella (German measles)
- B Hepatitis
- C Flu
- D Tetanus

Problem solving

Your teacher will tell you if you are in the Red group or Green group.

Red group

You are a worried parent who thinks that the risk of having a child vaccinated is too great.

Green group

You are a doctor who agrees with using the vaccine.

You will need two highlight pens, red and green. (If you do not have highlighters, use felt tip or ball point and underline)

Read the following arguments about whether children should be vaccinated using the Mumps, Measles, Rubella (MMR) vaccine. Some people think that the vaccine is dangerous and can cause brain damage and autism. Other people think that the risks of catching the diseases, and their long term effects, are greater than the supposed risk from the vaccination.

After reading each argument, mark it with a highlighter pen of the colour of the group who might support it.

Look at the arguments that your group would make. Now you need to make the decision for your group.

Do you think that parents should have their child vaccinated with the MMR vaccine?

Arguments

- The vaccine may not always give full protection against the diseases.
- An epidemic of measles would put a severe strain on resources.
- It was many years since the last epidemic and children's natural resistance will be low.
- Injections can sometimes be painful.
- If a large majority of children are vaccinated, it will stop the disease from spreading.
- Measles can result in permanent deafness.
- Modern techniques mean that injections hardly hurt at all.
- Mumps can result in men becoming sterile.
- Children catch these diseases all the time and they are just a minor inconvenience.
- We will be spending more money on beds and nurses.
- There is no evidence that the vaccine causes autism or brain damage.
- Statistics show that it is much better to have the injection than to gamble on not catching the disease.

Suggested alternative starter activities (5–10 minutes)

Recap last lesson	Share learning objectives	Problem solving (1)	Capture interest (1)	Capture interest (2)
Play the 'Who am I?' game.	<ul style="list-style-type: none"> Find out about how people stopped the spread of disease before microorganisms were discovered. Find out about modern day methods. Be able to explain how a theory can be tested by collecting evidence. (Sc1) 	Using SARS as an example, give examples of causes of disease and ask students how they would test to find out which was the correct cause (just to show how difficult it is). Beware – pupils could raise the issue of testing on live animals.	Show a video clip of people in China wearing face masks during the SARS outbreak. <i>Catalyst Interactive Presentations 2</i>	Introduce the idea of placebos by asking 'Does colour affect how good a medicine is?'

Recap last lesson

- Play the 'Who Am I?' game. Slowly read out a description of a famous scientist. Pupils identify the correct person. Pupils score the number of points indicated by the statement at which they correctly identify the person. This game will involve some trust that the pupils mark their own scores correctly. → [Teacher sheet](#)

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about how the spread of disease can be prevented. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils look at a list of possible causes for a disease. They decide how a scientist could investigate these possible causes to find the true cause of the disease. → [Pupil sheet](#)
- Discuss their ideas and identify the most likely methods.

Capture interest (1)

- Pupils are shown a video clip of people wearing face masks in China during the SARS outbreak. They are then asked to write a diary account of a doctor who is treating someone with SARS and what it must feel like to want to help someone who is ill, but at the same time being frightened of catching the disease. → *Catalyst Interactive Presentations 2*

Capture interest (2)

- Show pupils a range of different coloured Smarties. Do not tell them that they are Smarties, but ask them if they were medicines to cure disease, which colour tablets would work the best. Many people think that purple tablets work better than white ones. Mention the idea of placebos.
- Ask pupils to suggest how microorganisms could cause each of the diseases.

Recap last lesson

Teacher sheet

Jenner

Born 17 May 1749.

He was a doctor.

He died in 1823.

His method of working would never have been allowed today.

He worked with milkmaids.

He experimented on an eight-year-old boy.

He discovered the cure for smallpox.

7 points

6 points

5 points

4 points

3 points

2 points

1 point

Lister

Born in 1827.

Died in 1912.

Born in Essex, England.

He was a doctor.

He worked in Scotland.

He worked in a hospital in Glasgow.

He believed operating theatres should be clean.

He used carbolic acid to sterilise surgical equipment.

He reduced the number of deaths from surgery.

9 points

8 points

7 points

6 points

5 points

4 points

3 points

2 points

1 point

Fleming

Born 1881.

Died 1955.

Born in Ayrshire, Scotland.

Worked in London.

His work saved the lives of millions of people.

He grew bacteria on Petri dishes.

One of his dishes grew a mould.

He discovered penicillin.

8 points

7 points

6 points

5 points

4 points

3 points

2 points

1 point

Snow

He lived in 1854.

He worked in London.

He investigated a disease that broke out in Broad Street in London.

Other doctors thought the disease was spread by bad air.

He collected data from a brewery.

He thought the disease was spread by polluted water.

The disease was called cholera.

When he closed the well in Broad Street the disease disappeared.

8 points

7 points

6 points

5 points

4 points

3 points

2 points

1 point

Finley and Reed

They lived in 1881.

One lived in Cuba.

One did an experiment with people's clothing.

One worked with insects.

One worked with army volunteers.

The disease they were investigating was yellow fever.

6 points

5 points

4 points

3 points

2 points

1 point

Problem solving

Look at the different possible causes of disease.

For each one, make notes on how you as a scientist could investigate each possible cause to discover if it was the actual cause of a mystery new disease, e.g. SARS.

Remember, you use ethical methods - human beings cannot be experimented on!

Coughs and sneezes

Direct contact

Animal bites

Contaminated food or water

Suggested alternative starter activities (5–10 minutes)

Bridging to the unit	Setting the context	Concrete preparation (1)
Pupils discuss what colour tablet they think works best.	Introduce the use of placebos.	Brainstorm ideas to test the hypothesis that purple tablets are more effective than white ones.

Bridging to the unit

- Pupils are given a sheet with different coloured tablets on it. They are asked to rank the tablets in order. Number 1 being the most effective tablet and number 5 being the least effective tablet. They are given no other information.
- Pupils are then asked to feed back their ideas. List on the board the number of pupils for each colour for two categories, i.e. the most effective colour and the least effective colour. You will most likely find that purple is thought to be most effective by most pupils and white least effective.

→ [Pupil sheet](#)

Setting the context

- Introduce the idea of using placebos and the fact that placebos sometimes work.

Concrete preparation

- Pupils brainstorm ideas to test the hypothesis that purple tablets work better than white ones. Ideas about double blind trials could be introduced in order to stop the doctor's knowledge about what is in the tablets, influencing the results.

Bridging to the unit

Look at the pictures of different tablets. Put the tablets in order starting with number 1 for the tablet you think will be the most effective in treating a disease and number 5 for the tablet you think will be least effective.



blue



white



yellow



purple



green

Your teacher will collect your answers and collate them on the board.

Bridging to the unit

Look at the pictures of different tablets. Put the tablets in order starting with number 1 for the tablet you think will be the most effective in treating a disease and number 5 for the tablet you think will be least effective.



blue



white



yellow



purple



green

Your teacher will collect your answers and collate them on the board.

Type	Purpose	Differentiation
Practical	Pupils grow microorganisms on nutrient agar in a Petri dish.	Core

Running the activity

Safety aspects should be explained to pupils first. It is possible for rogue microorganisms to grow on the agar and reach dangerous numbers. It is most important that pupils do not remove the lid of the dish once it has been incubated.

Pupils add yoghurt bacteria to agar and then leave them to be incubated for a couple of days until the next lesson.

Expected outcomes

Lactobacillus should grown in a zigzag pattern on the agar in the Petri dish.

Pitfalls

It is vital that live and not pasteurised yoghurt is used for this experiment. Plain, unflavoured, live yoghurt works best.

Answers

- ① Answers will vary but pupils should see a series of zigzag lines where the lactobacillus has grown.
- ② From the yoghurt. The colonies will be big enough to see very easily. They will have multiplied so much that the large numbers are now visible.

Type	Purpose	Differentiation
Practical	Pupils grow microorganisms on nutrient agar in a Petri dish.	Core

Other relevant material

Plastic sterile disposable Petri dishes are cheap and save time autoclaving glass ones.

Equipment

For each group:

- Petri dish containing nutrient agar. The agar should be suitable for growing lactobacillus in yoghurt. Suitable agar tablets with appropriate nutrients can be obtained from any biological supplier
- approximately one teaspoon of yoghurt per pupil in a suitable container
- clock or watch
- 250ml beaker containing 100ml of distilled (sterile) water
- cotton bud
- marker pen.

For your information

Running the activity

Safety aspects should be explained to pupils first. It is possible for rogue microorganism to grow on the agar and reach dangerous numbers. It is most important that pupils do not remove the lid of the dish once it has been incubated.

Pupils add yoghurt bacteria to agar and then leave them to be incubated for a couple of days until the next lesson.

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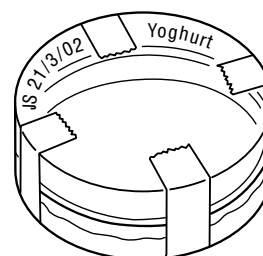
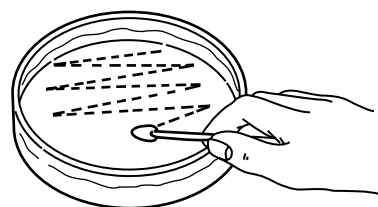
It is vital that live and not pasteurised yoghurt is used for this experiment. Plain, unflavoured, live yoghurt works best.

Microorganisms live all around us. Most of them are quite harmless. In this experiment you are going to grow some of them in a Petri dish. The dish contains a jelly called agar. The agar contains all the nutrients that the microorganisms need to grow. Yoghurt is made using microorganisms. You are going to grow the microorganism found in yoghurt.

Equipment

- Petri dish containing nutrient agar
- yoghurt
- 250 ml beaker containing 100 ml of distilled water
- cotton bud
- marker pen

- 1 Add a teaspoon full of yoghurt to your beaker of water and mix together.
- 2 Dip the cotton bud into the yoghurt solution.
- 3 Open the lid of the Petri dish and wipe the cotton bud all over the jelly in a zigzag pattern. **Do not press too hard!**
- 4 Put the lid back on the dish.
- 5 Use the marker pen to label the lid with the date, your initials and 'Yoghurt'
- 6 Seal the lid to the base with four pieces of sticky tape.
- 7 Give the dish to your teacher. Your teacher will return it to you in a couple of days when the microorganisms have grown. **Do NOT open the dish! It may contain dangerous microorganisms!**



- ① Has anything grown on your Petri dish? If so, draw a diagram of what you can see.
- ② Where do you think the microorganisms came from?

Type	Purpose	Differentiation
Paper	Pupils show that they understand how microorganisms grow and increase in number over a period of time.	Extension

Running the activity

Pupils work through the worksheet and do some calculations about cell division.

Pitfalls

For question 3, some pupils will assume that the yeast cells will double in number every hour. Other pupils may realise that growth will slow down as resources become scarce and produce a sigmoid growth curve.

Safety notes

Normal classroom safety procedures.

ICT opportunities

Pupils could search the Internet for different growth rates for different microorganisms.

Answers

- ① Food, warmth and water.
- ② After four hours there would be 4096 bacteria.
- ③ Answers will vary. Some pupils will double the number of yeast cells every hour. Some pupils may realise that growth will slow as resources become scarce.

You are going to do some calculations about cell division.

To grow well, microorganisms need to be kept warm and moist and have plenty of food.

Not all microorganisms need oxygen. For example, yeast feeds on sugar. Yeast can respire anaerobically, which means it can get the energy it needs to grow without using oxygen. It breaks down the glucose into carbon dioxide and ethanol. This is called fermentation.

glucose \rightarrow carbon dioxide + ethanol energy is released

Yeast reproduces by cell division. One cell divides to make two cells. The two cells grow a little bigger and then they also divide in two. In this way a population of yeast starts off small, but then becomes large very rapidly.

1 cell \rightarrow 2 cells \rightarrow 4 cells \rightarrow 8 cells \rightarrow 16 cells \rightarrow ...

If the conditions are right, then the yeast population would continue to grow like this. But as the population gets bigger and bigger it begins to grow more slowly as the yeast cells have to compete for food and space. Also, the ethanol that the yeast produces is a waste product. It builds up and slowly poisons the yeast.

- ① What do microorganisms need to grow well?
- ② There is a type of bacterium that lives in your gut called *E. coli*. If the conditions are right, it will divide every 20 minutes. This means that in just 24 hours one bacterium could, in theory, produce 4 722 366 482 869 650 000 000 offspring! Calculate how many bacteria there would be after four hours.
- ③ Paul and Angela carried out an experiment to monitor the growth of yeast. Here are some of their results.

Time in hours	0	1	2	3	4	5	6	7	8	9
Number of yeast cells	1	2	4	8						

- a Predict how the number of yeast cells will grow over the next six hours.
- b Plot these results as a line graph.
- c Describe the shape of your graph.
- d Do you think the population of yeast will continue to grow like this? What might happen to affect the yeast population as it gets bigger?

Investigate: What affects how yeast grows?

Type	Purpose	Differentiation
Practical	Pupils plan and carry out an investigation into the effect of temperature and sugar concentration on respiration in yeast.	Core , Help Resource 1 Resource 2

Running the activity

Before running the activity it may be a good idea to remind pupils that yeast uses sugar and oxygen to release energy, carbon dioxide and water. In this experiment, the carbon dioxide produced will be a measure of how quickly respiration is proceeding.

Core: Pupils first complete a planning exercise. They decide what variables could be measured and how the investigation could be carried out. Then divide pupils into groups.

Help: Resource sheet 1 is to help less able pupils with their planning. Some pupils may devise unrealistic experiments, in this case they can use the method described on the Help sheet to carry out the investigation. The Help sheet is for investigating the effect of temperature on the growth of yeast. Alternatively, they could investigate the effect of the amount of food needed to grow, as suggested on Resource sheet 1, in which case they would need to be given the table below. You can divide pupils into two groups to investigate one variable each.

Tube	Yeast solution (cm ³)	Sugar solution (cm ³)	Diameter of balloon (mm)
1	20	20	
2	20	20	
3	20	none	
4	none	20	

Other relevant material

[C1c Resource 1 and Resource 2](#)
[Skill sheet 8: Variables](#)
[Skill sheet 11: Risk assessment](#)

[Skill sheet 20: Writing frame: Planning an investigation](#)
[Skill sheet 21: Writing frame: Reporting an investigation](#)
[Skill sheet 24: Safety precautions](#)

Pitfalls

It is often useful to inflate and deflate the balloons a couple of times, prior to using them in the experiment, as it makes it easier for the carbon dioxide to inflate them.

Ensure yeast solution is made up the day before to use up all the sugar that might have been added by the manufacturer.

ICT opportunities

It would be possible to set up a spreadsheet for the results and draw a bar chart.

Answers

- ① To act as a control or words to that effect.
- ② Warm yeast with glucose. It had the balloon with the greatest diameter.
- ③ No yeast or yeast without sugar or yeast in ice. Answers will vary. The balloon with the smallest diameter.
- ④ Yeast needs sugar and warmth.
- ⑤ Controlling temperature accurately. A method for measuring the volume of gas in the balloons. Ensuring all samples are left for the same amount of time.

Investigate: What affects how yeast grows?

Type	Purpose	Differentiation
Practical	Pupils plan and carry out an investigation into the effect of temperature and sugar concentration on respiration in yeast.	Core , Help Resource 1 Resource 2

Other relevant material

[C1c Resource 1 and Resource 2](#)
[Skill sheet 8: Variables](#)
[Skill sheet 11: Risk assessment](#)

[Skill sheet 20: Writing frame: Planning an investigation](#)
[Skill sheet 21: Writing frame: Reporting an investigation](#)
[Skill sheet 24: Safety precautions](#)

Equipment

For each group:

- yeast solution made up to the manufacturer's instructions. It is advisable to make up the solution the day before the practical in order to ensure that any sugar added to the yeast has been fully used up
- sugar solution – concentration is not critical but approximately five teaspoons per 250ml works well
- clock or watch
- four boiling tubes labelled 1–4
- boiling tube rack
- 500ml beaker of warm water or water bath
- 500ml beaker containing ice
- four balloons
- marker pen
- suitable measuring cylinder, e.g. 100ml.

For your information

Running the activity

Before running the activity it may be a good idea to remind pupils that yeast uses sugar and oxygen to release energy, carbon dioxide and water. In this experiment, the carbon dioxide produced will be a measure of how quickly respiration is proceeding.

Core: Pupils first complete a planning exercise. They decide what variables could be measured and how the investigation could be carried out. Then divide pupils into groups.

Help: Resource sheet 1 is to help less able pupils with their planning. Some pupils may devise unrealistic experiments, in this case they can use the method described on the Help sheet to carry out the investigation. The Help sheet is for investigating the effect of temperature on the growth of yeast. Alternatively, they could investigate the effect of the amount of food needed to grow, as suggested on Resource sheet 1, in which case they would need to be given the table in the Teacher activity notes. You can divide pupils into two groups to investigate one variable each.

Expected outcomes

Core: Pupils should predict that conditions such as temperature, food, overcrowding, etc. affect growth. Pupils who plan correctly will be able to identify one condition to investigate and predict a possible outcome. It is not important that the prediction should be correct. Warm yeast with sugar should produce most carbon dioxide. Other results may vary but no yeast will produce no carbon dioxide.

Help: They should find that yeast grows best in warm conditions and needs food.

Pitfalls

It is often useful to blow the balloons up prior to using them in the experiment as it makes it easier for the carbon dioxide to inflate them.

Ensure yeast solution is made up the day before to use up all the sugar that might have been added by the manufacturer.

Investigate: What affects how yeast grows?

Yeast is a microorganism. It is a fungus that can respire to produce carbon dioxide and alcohol. You are going to investigate what conditions yeast needs for respiration.

Equipment

- yeast solution
- clock or watch
- four boiling tubes labelled 1- 4
- boiling tube rack
- four balloons
- marker pen
- measuring cylinder
- 500 ml beaker of warm water or water bath (optional)
- 500 ml beaker containing ice (optional)
- sugar solution (optional)

Planning and predicting

- 1 List all of the conditions that you think will affect how yeast grows.
- 2 Highlight which of these conditions you will measure.
- 3 Choose one of these conditions and predict how changes to the condition would affect how the yeast grows. Give your reasons.
- 4 Decide what you will measure and design a table to record your results.
- 5 Write a plan for your method, including the equipment you will use.

Obtaining evidence

- 6 Check your plan with your teacher before you start.

Considering the evidence

- 7 When you have completed your experiment, answer the following questions.
 - ① Explain why it is a good idea to set up one of the tubes with no yeast in it.
 - ② Explain which tube produced the most carbon dioxide. How do you know?
 - ③ Explain which tube produced the least carbon dioxide. How do you know?
 - ④ Explain what your results tell you about the best conditions for growing yeast.

Evaluating

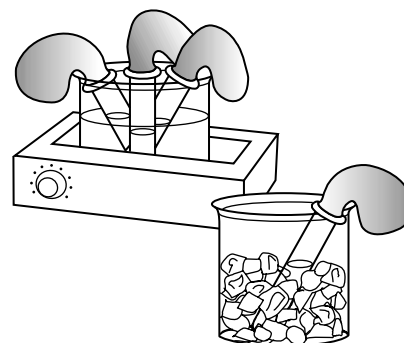
- ⑤ Explain one way that you could improve your experiment to make your results even more accurate.

Investigate: What affects how yeast grows?

Yeast is a fungus. It produces carbon dioxide and alcohol when it grows. You are going to find out what yeast needs to grow.

Equipment

- yeast solution
- sugar solution
- clock or watch
- four boiling tubes labelled 1-3
- boiling tube rack
- 500 ml beaker of warm water or water bath
- 500 ml beaker containing ice
- four balloons
- marker pen
- measuring cylinder



Obtaining evidence

- 1 Make sure the boiling tubes are labelled 1-3.
- 2 Set up the test tubes as shown in the table below.
- 3 Add sugar solution to all three tubes.

Tube	Yeast solution	Temperature	Diameter of balloon (mm)
1	20 cm ³	warm	
2	20 cm ³	cold	
3	none	warm	

- 4 Place a balloon over the end of each test tube. Pinch the balloon to make sure that it contains as little air as possible. The balloon is to collect the carbon dioxide gas.
- 5 Place the boiling tubes into warm water and ice as shown in the table.
- 6 Leave for 20 minutes.
- 7 Measure the diameter of each balloon and record the results in the above table.

Investigate: What affects how yeast grows?

Use this sheet to help you plan your investigation.

Planning and predicting

Write down the things you think that yeast might need to grow:

- 1
- 2
- 3
- 4

You are going to investigate the amount of food yeast needs to grow or the ideal temperature for it to grow. Your teacher will tell you which you will do. Fill in one of the predictions below for your investigation.

I predict that if I increase the amount of food, the yeast will

.....

.....

.....

.....

I predict that if I lower the temperature, the yeast will

.....

.....

.....

.....

Investigate: What affects how yeast grows?

Use this sheet to help you analyse your results.

Considering the evidence

Look at the results of your investigation. Complete the sentences below to help you describe your results.

The balloon with the most gas in it was number

The balloon with the least gas in it was number

Yeast grows best when it has

.....

.....

Tube had no yeast in it. This was so that

.....

.....

.....

Type	Purpose	Differentiation
Paper	Pupils understand how the body protects itself from the invasion of microorganisms.	Core

Running the activity

Pupils label a diagram of the human body with the correct pre-prepared statements about natural defences.

ICT opportunities

Pupils could search the Internet for how the body protects itself against disease.

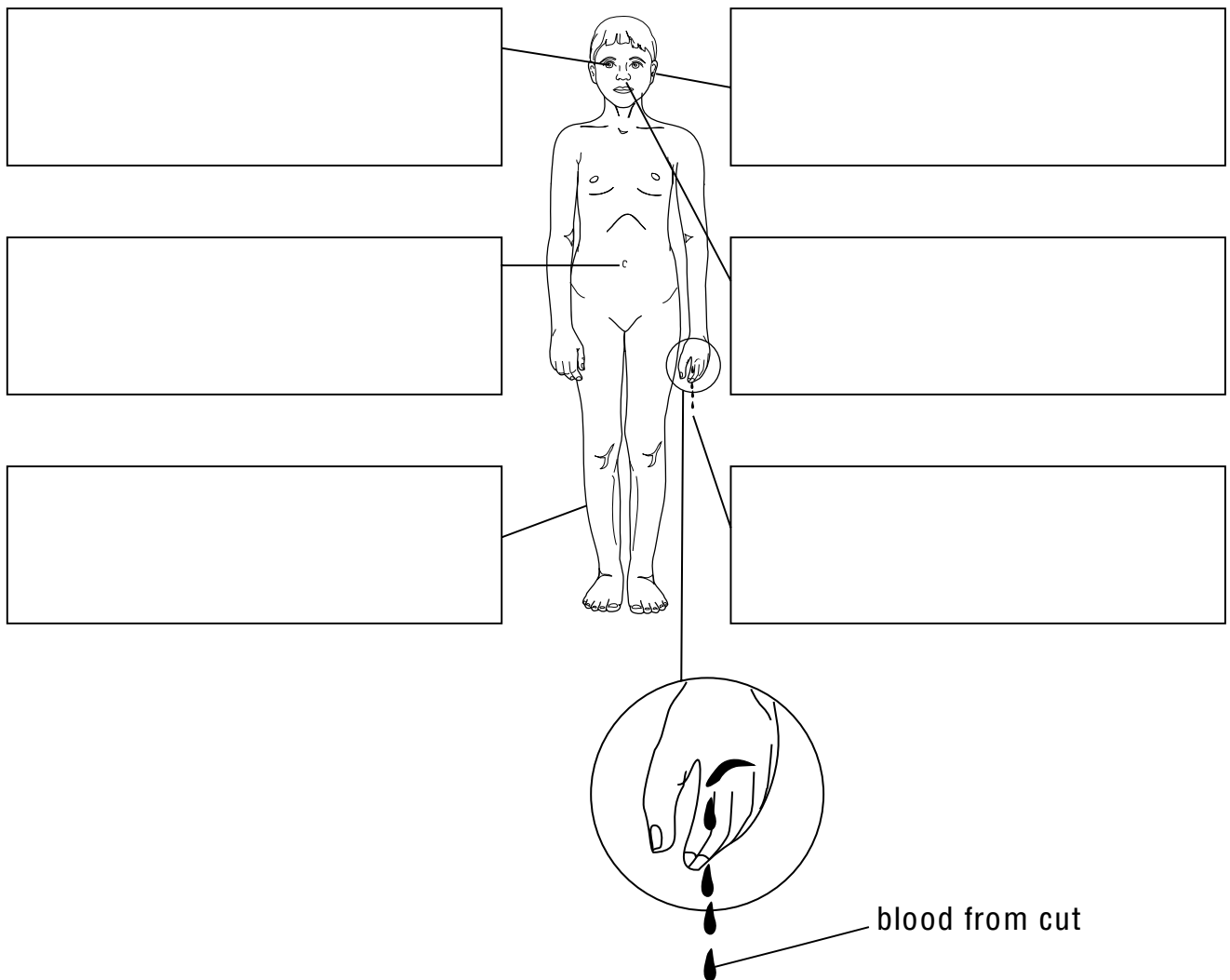
Answers

- A** To stomach.
- B** To nose.
- C** To blood.
- D** To ears.
- E** To skin surface.
- F** To eyes.

You are going to label a diagram of the human body to show its natural defences against disease.

Label the diagram by writing the following statements in the correct boxes.

- A** Contains acid that kills microorganisms on our food.
- B** Sticky mucus and hairs prevent microorganisms getting into our lungs.
- C** Contains white blood cells that destroy microorganisms.
- D** A waxy substance that traps microorganisms.
- E** A defensive layer that prevents microorganisms entering our body.
- F** Produces a fluid that washes out and kills microorganisms.



Type	Purpose	Differentiation
Practical	Pupils use a microscope to examine a prepared blood slide to show white blood cells.	Core

Running the activity

Pupils should be taught how to use a microscope safely so as not to smash slides and damage objective lenses by racking the objective lens down through the slide.

Expected outcomes

Pupils should be able to identify white blood cells; draw a simple diagram; and realise that the number of white blood cells is significantly less than red blood cells.

Pitfalls

Some types of microscopes will allow the objective lens to be racked down and smash the slide. This may also damage the objective lens. Pupils will need to be well trained in the use of a microscope.

Safety notes

Broken slides produce sharp shards of glass. Students should be warned of the danger of using daylight illumination microscopes. If they are used where sunlight can strike the mirror the user could be blinded.

ICT opportunities

Pupils could search the Internet for further information about blood products and the uses that blood is put to by the National Blood Service.

[National Blood Service website](#)

Answers

- ① Answers may vary but usually blue.
- ② Answers will vary depending upon size of drawing.
- ③ All cells are small/to pass through blood vessels/any other suitable answer.
- ④ Answers will vary depending upon microscope.

Type	Purpose	Differentiation
Practical	Pupils use a microscope to examine a prepared blood slide to show white blood cells.	Core

Equipment

For each group:

- one microscope with lenses capable of observing white blood cells
- one prepared slide of blood with the white cells stained.

For your information

Running the activity

Pupils should be taught how to use a microscope safely so as not to smash slides and damage objective lenses by racking the objective lens down through the slide.

Expected outcomes

Pupils should be able to identify white blood cells; draw a simple diagram; and realise that the number of white blood cells is significantly less than red blood cells.

Pitfalls

Some types of microscopes will allow the objective lens to be racked down and smash the slide. This may also damage the objective lens. Pupils will need to be well trained in the use of a microscope.

Safety notes

Broken slides produce sharp shards of glass. Students should be warned of the danger of using daylight illumination microscopes. If they are used where sunlight can strike the mirror the user could be blinded.

You are going to look at white blood cells under a microscope.

Equipment

- microscope
- prepared slide of blood stained to show white blood cells

Obtaining evidence

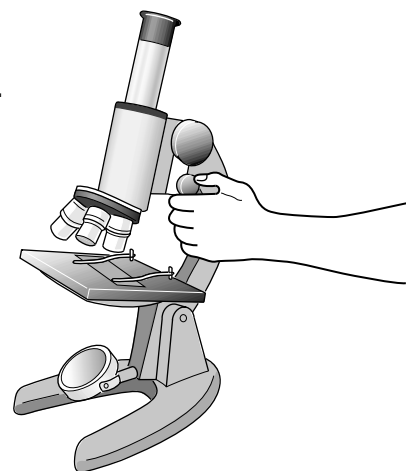
- 1 Put the slide on the microscope stage and focus the microscope on a group of cells using low power.
- 2 Carefully move the slide around while looking through the eyepiece, until you can see a cell that is different from the rest. It may be stained a different colour, such as blue.
- 3 Carefully rotate the objective lens to medium or high power and refocus using the fine focussing knob.
- 4 Draw a group of about five cells, including a white blood cell. Make sure you give the drawing a heading and labels.

- ① What was the colour that the white blood cells had been stained?
- ② White blood cells are approximately 0.01 mm wide. Measure the width of your drawing of a white blood cell in millimetres, using a ruler. Now calculate the magnification of your drawing. *Hint:* divide the width of your drawing by 0.01.
- ③ Suggest a reason why white blood cells are so small.
- ④ Look at the eyepiece and objective lenses on your microscope. They will both have a number on them telling you how many times they magnify. Multiply both of these numbers together to work out the magnification of your microscope. What was the magnification that you used?



Prepared slides are expensive.

Take care with them. Broken glass slides are very sharp and can be dangerous. Never use a microscope where the Sun can reflect off the mirror into your eyes. You could blind yourself permanently.



Type	Purpose	Differentiation
Practical	Pupils are going to investigate the effectiveness of bleach, antiseptics and disinfectants in killing microorganisms.	Core

Running the activity

Ensure the lids are stuck down with tape when the pupils receive the dish and instruct them not to remove the lid until told. Then issue the soaked discs in a labelled container. Instruct pupils to remove the lid (this is a special case and normally Petri dish lids should never be removed). They must not touch the bacteria with their hands but place the discs onto the surface of the agar with forceps. Their position noted, the lid quickly returned and sealed and labelled with the solution name and position of each disc.

Expected outcomes

Water will have no effect. All other solutions will have varying degrees of success and should produce a clear zone around the disc where the solution has diffused out killing the bacteria. The greater the clear zone, the more effective the solution is in killing bacteria.

Pitfalls

Pupils should be warned not to leave the lid off the Petri dish for longer than needed when adding the discs to the agar. They need to make a careful note of the position of each disc so that the label on the Petri dish lid matches the correct disc. Pupils should not touch the discs with their hands, but use forceps.

Safety notes

Pupils should wear eye protection. The discs should be pre-soaked in the appropriate solutions, diluted as required. However, pupils should be told not to touch the soaked discs with their fingers.

ICT opportunities

Pupils could search the Internet for other naturally occurring chemicals that have microorganism killing properties.

Answers

- ① The bacteria have been killed by the chemical. The chemical diffused out from the filter paper.
- ② Answers may vary but 'water' will not be a correct answer.
- ③ To act as a control/fair test.

Type	Purpose	Differentiation
Practical	Pupils are going to investigate the effectiveness of bleach, antiseptics and disinfectants in killing microorganisms.	Core

Equipment

For each group:

- bacteria growing in a Petri dish. They will need to have been prepared several days before and one ready may be stored for a few days in a fridge. The non pathogenic bacteria and suitable agar may be obtained from any biological supplier
- sticky tape
- tweezers/forceps
- marker pen to write on glass or plastic
- discs of filter paper (1 cm diameter) soaked in bleach, antiseptic, disinfectant or distilled sterile water. The bleach, antiseptic and disinfectant should be diluted as per the manufacturers instructions, and not used neat.

For your information

Running the activity

Ensure the lids are stuck down with tape when the pupils receive the dish and instruct them not to remove the lid until told. Then issue the soaked discs in a labelled container. Instruct pupils to remove the lid (this is a special case and normally Petri dish lids should never be removed). They must not touch the bacteria with their hands but place the discs onto the surface of the agar with forceps. Their position noted, the lid quickly returned and sealed and labelled with the solution name and position of each disc.

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Safety notes

Pupils should wear eye protection. The discs should be pre-soaked in the appropriate solutions, diluted as required. However, pupils should be told not to touch the soaked discs with their fingers.

You are going to investigate how effective bleach, antiseptic, disinfectant, and antibiotics are at killing microorganisms.

Equipment

- bacteria in a Petri dish
- sticky tape
- tweezers
- marker pen
- pieces of filter paper soaked in bleach, antiseptic, disinfectant, antibiotic and water



Wear eye protection.

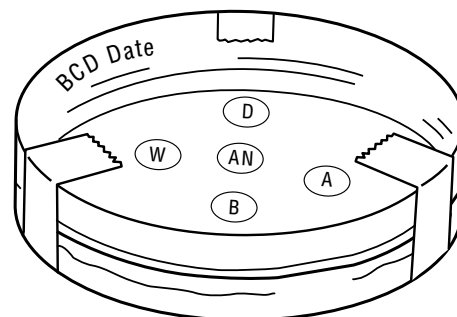


Do not remove the lid of the

Petri dish after you have added the filter paper. Dangerous bacteria may grow in it. Secure the lid safely in three places with the sticky tape provided.

Obtaining evidence

- 1 Use the forceps to pick up one of the five pieces of filter paper.
- 2 Open the lid of the Petri dish and place the piece of filter paper on the agar jelly, about 2cm away from the edge of the dish.
- 3 Put the lid back on the dish.
- 4 Use the marker pen to label the lid of the Petri dish just above the piece of filter paper.
- 5 Repeat steps 2- 4 for the other four pieces of filter paper.
- 6 Place the forceps into the sterilising solution provided.
- 7 Seal the dish with at least three pieces of sticky tape.
- 8 Give your dish to your teacher. It will be incubated for a couple of days to allow the bacteria to grow.



When your Petri dish is returned to you, **do not open the dish**. Look carefully at the area around each piece of filter paper. The cloudy areas on the jelly are where the bacteria have grown.

Draw a diagram of the surface of the jelly and label each of the pieces of filter paper.

- ① Suggest why there are some clear areas around some of the pieces of filter paper.
- ② Which piece of filter paper was most effective in killing the bacteria?
- ③ Why do you think that one piece of filter paper was soaked in water?

Type	Purpose	Differentiation
Discussion	Pupils discover that antibiotics are only of use against bacterial infections and not viral ones.	Core Resource

Running the activity

Divide the class into pairs and issue each pair with the resource sheet. One pupil takes the role of the doctor, the other of the patient. Allow 10 minutes for discussion to take place between each pair regarding the use of antibiotics to treat a common cold. At the end of 10 minutes, selected pairs can be chosen to role play the doctor/patient discussion.

Other relevant material

C3b Resource – this provides information regarding the roles of the doctor and patient.

ICT opportunities

Pupils could search the Internet for diseases that can be treated with antibiotics.

Answers

- ① no
- ② Answers will vary but could include reference to schools, media, leaflets in doctors surgeries, etc.

In this activity you are going to role play a conversation between a doctor and his patient.

The patient has a viral infection and has gone to the doctor to get a prescription for some antibiotics. The doctor is trying to persuade the patient that he is better off without the antibiotic. The patient disagrees. The person playing the role of the doctor has to persuade the patient that they do not need any antibiotics.

- 1** Divide into groups of two. One will be the patient, the other will be the doctor.
 - 2** Read the resource sheet for your character and prepare for your role play.
 - 3** Some groups may be asked to perform their role play in front of the whole class.
 - 4** After the role play complete the following questions.
- ① Should the doctor prescribe antibiotics for a cold?
 - ② Suggest how people can be educated to know what is best for them when they have a viral infection.

In this activity you are going to role play a conversation between a doctor and his patient.

The patient has a viral infection and has gone to the doctor to get a prescription for some antibiotics. The doctor is trying to persuade the patient that he is better off without the antibiotic. The patient disagrees. The person playing the role of the doctor has to persuade the patient that they do not need any antibiotics.

- 1** Divide into groups of two. One will be the patient, the other will be the doctor.
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 - 4** After the role play complete the following questions.
- ① Should the doctor prescribe antibiotics for a cold?
 - ② Suggest how people can be educated to know what is best for them when they have a viral infection.

Doctor

Colds are caused by a virus.

Antibiotics do not work against viruses.

Antibiotics only work against some bacteria.

Antibiotics are expensive.

Overusing antibiotics can cause bacteria to develop resistance to them, making them useless.

The best treatment for a cold is rest, keeping warm and drinking plenty of liquids.

Patient

You have a cold.

You feel miserable.

You need to return to work or you will lose some of your wages.

Last time you had a cold you were off work for a week.

Last time you had a cold another doctor prescribed antibiotics.

Type	Purpose	Differentiation
Paper	Pupils carry out a data interpretation exercise to determine what vaccinations are required when going on holiday to different countries.	Core Resource

Running the activity

Pupils are provided with the resource sheet and then asked to answer a series of questions.

Other relevant material

C4a Resource

ICT opportunities

Pupils could search the Internet for vaccinations required for travelling to other countries not mentioned on the table.

Answers

- ① All on the list as even though Africa is not always mentioned by name, it is referred to indirectly in all examples.
- ② Some vaccines three months before leaving this country, others only ten days. It depends upon the vaccine.
- ③ In contaminated food and water. Through cuts. Breathed into the lungs.
- ④ Vaccines encourage the body to make antibodies to fight off a possible future infection.
- ⑤ Sleep inside a mosquito net and drink only bottled water unless you are sure the local water supply is safe.

One of the risks of going on holiday to foreign places is that you may catch diseases that do not normally occur in this country.

You are going to find out how you can protect yourself from diseases on holiday by having vaccinations. You are going on holiday to Africa in six months time. You expect to travel to different places in Africa.

Look at the information on the resource sheet and then answer the following questions.

- ① What vaccinations would it be sensible to have before travelling to Africa?
- ② When would you need to have these vaccinations?
- ③ List three ways that different microorganisms can get into the body.
- ④ Explain simply what a vaccine is and how it works.
- ⑤ Apart from vaccinations, what other precautions would it be sensible to take when travelling around Africa?

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- ④ Explain simply what a vaccine is and how it works.
- ⑤ Apart from vaccinations, what other precautions would it be sensible to take when travelling around Africa?

Disease	Risk area	Infection type	Vaccination needed	See your doctor
Diphtheria	Major risk in the former USSR, some risk in developing countries.	Bacteria airborne - transmitted person-to-person through close contact and respiratory contact.	Three injections one month apart. Low dose adult booster vaccine lasts 10 years.	Three months before travel.
Hepatitis A	All travel outside Western Europe, USA and Canada, Australia and New Zealand.	Virus caught from contaminated water and food, especially seafood.	One injection with a booster at six to twelve months.	Two to four weeks before travel.
Meningitis	Central to Southern Africa, Saudi Arabia, Northern India and Nepal.	Bacteria spread by airborne droplets.	One injection protects against meningitis A and C for three years.	Seven to ten days before travel.
Polio	All travel outside Western Europe, USA and Canada, Australia and New Zealand.	Virus via water, contaminated food and close contact with infected people.	Mouth drops - three doses at one month intervals if never immunised. Booster every 10 years.	Three months before travel if not already immunised.
Rabies	Some risk in most nations outside UK, Australia and New Zealand.	Virus via animal bite or lick.	Two or three injections if going to high risk areas or long stay. Injections on days 0, 7 and 28 after the bite.	Four weeks before travel.
Tetanus	world-wide	Bacterial infection possible following grazes or cuts.	Protection advisable. Booster lasts 10 years.	Three months if not already immunised.
Typhoid	In any country with poor sanitation.	Bacteria through contaminated food or water.	Single injection protects for three years.	Ten days before travel.
Yellow fever	Africa and Northern regions of South America.	Virus transmitted through mosquito bites.	Vaccine takes 10 days to provide cover and lasts for 10 years.	Vaccine can only be given by a World Health Organisation yellow fever centre.

Data taken from Medical Advisory Services for Travellers Abroad (MASTA), within the leaflet 'Malaria' produced by The Boots Company plc. (Jan 2000).

Type	Purpose	Differentiation
ICT	Pupils produce a presentation on the life and work of a famous scientist.	Core Resource

Running the activity

Pupils work in pairs to produce a presentation on the life and work of a famous scientist (either Jenner, Snow or Lister). They are provided with an instruction sheet and a resource sheet as a starting point but will need to do further research for their presentation.

Selected pairs of pupils can then give their presentation to the rest of the class.

Other relevant material

[C4b Resource](#)

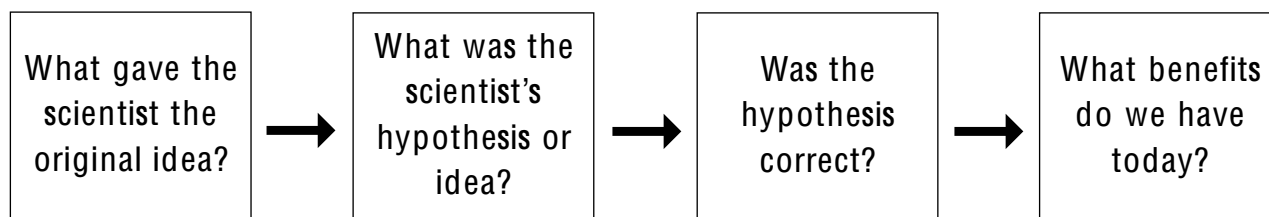
[Skill sheet 4: Web searches](#)

ICT opportunities

Pupils could search the Internet for further information about either Jenner, Snow or Lister.

The reason that we have such good health care today, is because of the discoveries made and the work done by scientists many years ago. You are going to prepare a presentation about one of the scientists.

- 1** Look at the resource sheet. It tells the life stories of three different scientists who made some of the discoveries.
- 2** Read the life stories carefully. Working with a partner choose one of the life stories to study in more detail.
- 3** Use other sources of information, such as the Internet, CD-ROMs or textbook to gather further information about your chosen scientist.
- 4** You are now going to present your information to the rest of the class. You may do this in one of the following ways:
 - a newspaper article
 - a TV news report
 - a PowerPoint® or similar presentation.
- 5** You should organise your presentation using the flow chart shown below.



Edward Jenner

Edward Jenner was born on 17 May 1749. He trained as a doctor and became interested in a disease called smallpox. Smallpox was a major killer 200 years ago and people were very frightened of catching it.

Jenner noticed that milkmaids who caught a similar but much milder disease, called cowpox, never seemed to catch the more deadly smallpox. He made a hypothesis that something from the cowpox protected people from catching smallpox.

He decided to test his hypothesis. He persuaded a mother, to let him inject some cowpox pus into the arm of her eight-year-old son. The boy soon developed cowpox and quickly recovered. Six weeks later, he injected the boy with the deadly smallpox pus. The boy stayed healthy and did not develop smallpox. Jenner was convinced he had found the answer to smallpox.

After a lot of debate and argument, doctors all over the country began injecting people with cowpox pus. The experiment was a great success and soon other scientists were looking for ways of developing vaccines against other diseases.

John Snow

John Snow was a doctor who lived in London in 1854. There was an outbreak of a very serious disease called cholera. Most other doctors thought that people caught cholera by breathing in bad air but Dr Snow disagreed with them.

By talking to his patients he discovered that all of the ones who had caught cholera had drunk water taken from the same well. People who drank water from other wells did not catch the disease. He became convinced that drinking polluted water caused people to catch the disease.

He also noticed that workers in a local brewery did not catch the disease. He discovered that they drank beer all day rather than water from the local well. A woman who lived many miles away in Hampstead caught cholera. Dr Snow discovered that she had been sent a bottle of water from the suspect well.

Dr Snow felt that he had gathered enough evidence to form his hypothesis that the local well was the cause of the disease. He had the well closed down and soon the cholera outbreak was over.

Joseph Lister

Joseph Lister was born in 1827. He trained as a doctor and was appointed to a hospital in Glasgow. He treated patients who got infections after operations. In those days it was common for some people who had an operation to develop gangrene and die.

Most doctors believed that the infection was caused by bad air. Doctors wore old blood stained clothing (patients thought that the doctor was experienced if they had blood all over their clothing) and rarely cleaned their surgical equipment. Operating theatres were dirty blood stained places.

Even though Lister tried to keep his operating theatre clean, over half his patients still died from infection. Lister decided to clean all his equipment and spray the operating theatre with carbolic acid. This was the first time an antiseptic or disinfectant had been used.

Soon the death rate infections had been reduced from half to only 15 per cent. It still took him another ten years to convince other doctors of his discovery.

Type	Purpose	Differentiation
Paper	Pupils use a graph to determine the effect of introducing a vaccine against measles on the incidence of the disease.	Extension

Running the activity

Pupils are provided with a graph and answer questions about it.

ICT opportunities

Pupils could search the Internet for the effect of introducing vaccination on the incidence of other infectious diseases.

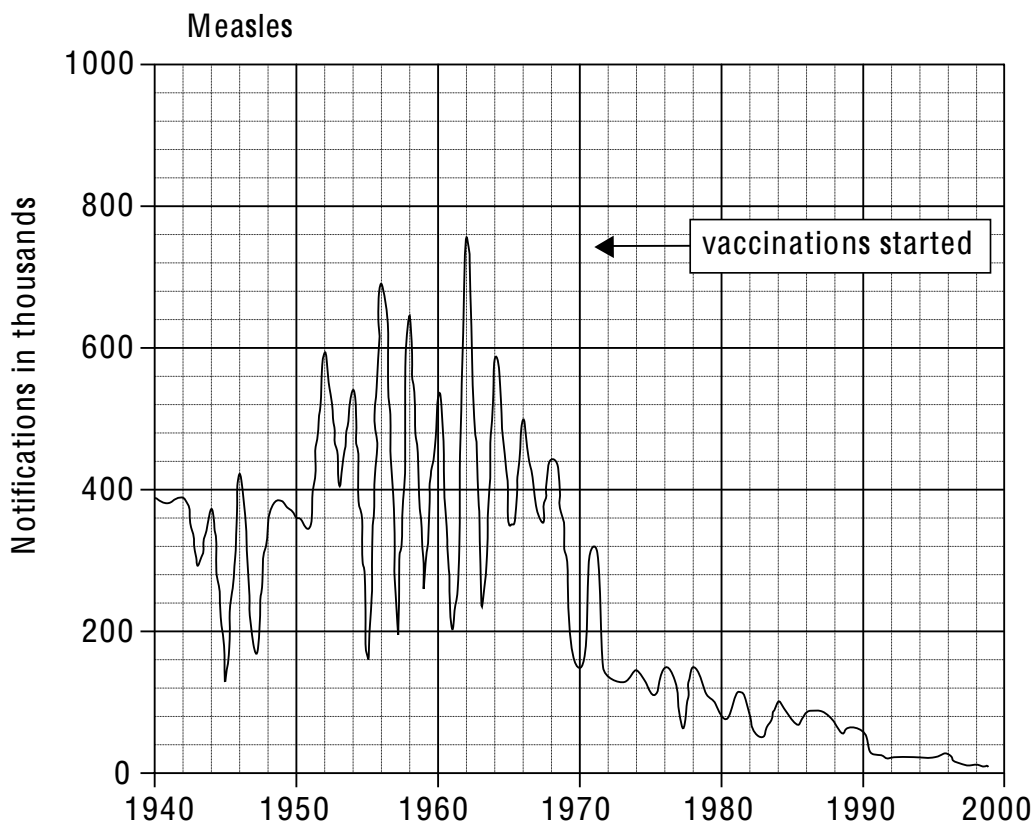
Answers

- ① Approximately 750 000.
- ② Number fell – more able pupils will say fell and rose but overall gradual fall.
- ③ Improved health care, awareness.
- ④ Outbreak causes numbers to rise. More people now have immunity so numbers fall. Cycle is repeated.
- ⑤ As less children are vaccinated, the number of cases of measles could rise.
Could lead to measles epidemic.

Measles is a very serious disease. Although most children who catch it recover completely after a few days, sometimes it can result in serious complications such as brain damage or deafness.

You are going to study a graph showing how the number of measles infections has changed since vaccination was introduced in 1971.

Look at the graph. It shows how vaccination has reduced the number of cases of the disease.



- ① What was the number of cases of measles in 1962?
- ② State what happened to the number of cases of measles after mass vaccination was started.
- ③ Suggest why the number of cases of measles was dropping before mass vaccination started.
- ④ Suggest why between 1955 and 1965, the number of cases went up and down so much each year.
- ⑤ Measles vaccine is now given as part of the MMR vaccine that also protects against mumps and rubella. Some parents are worried that this triple vaccine can cause a disease called autism and are not having their children vaccinated. Suggest what this could do to the number of cases of measles.

Type	Purpose	Differentiation
Discussion	Pupils consider the moral dilemma faced by the residents of Eyam during the plague.	Core

Running the activity

Pupils are placed into three groups to consider and discuss different options available to the people of Eyam. A class feedback can then be used to consider them.

ICT opportunities

Pupils could search the Internet for historical evidence about other diseases.

Answers

- ① Answers will vary. It is not the answer that is important, more the thinking and discussion that produced the answer.
- ② Answers will vary.

The 'story of Eyam' tells how the Bubonic Plague was spread by fleas hidden on cloth that was sent from London to Eyam. The villagers decided to isolate themselves from the rest of the world and let the disease take its course. They had no idea what was causing the disease; it must have been a terrifying experience for them.

You are going to be divided into groups. Each group will discuss a different solution for dealing with the news of the disease reaching their village. You may then be asked to give a short presentation of your thoughts.

Read the story in your textbook again. Then, discuss with your group how you would have felt about the solution you are considering.

Group 1

Do what the villagers of Eyam did. Stay put and wait until the outbreak of the disease had finished.

Group 2

Put people who caught the disease in isolation in a small house on the outskirts of the village and leave food and water for them outside the house. The rest of the villagers carry on with their normal lives.

Group 3

All the people leave the village and scatter; going to stay with friends and relatives in other villages. They would only return to their own village when the plague was over.

- ① Which of the above alternatives do you think was the correct thing to do? Explain your answer.
- ② Which of the above alternatives would you have done if you had lived in the village of Eyam? Be honest!

Type	Purpose	Differentiation
ICT	Pupils research a disease of their choice and produce a poster to show their findings.	Core

Running the activity

Access to the Internet is required.

Pupils use the Internet to research a specific disease. The second half of the lesson is used by the pupils to produce an A3 size poster of their findings. They should be encouraged to keep the poster simple and uncluttered and use colour and large designs.

ICT opportunities

Pupils search the Internet for information about selected diseases.

You are going to use the Internet to research the causes and possible solutions of some modern-day epidemics and then produce a poster based on your findings.

- 1** First of all decide which disease you wish to research.
Some examples include:
AIDS
flu (influenza)
cholera
mumps
measles.
- 2** Decide on which Internet search engine you wish to use.
Some good ones include:
[Ask Jeeves](#)
[Yahoo!](#)
[Google](#)
- 3** Decide on which key words you are going to use in your search.
For example, you might use:
epidemic
AIDS (or other named disease)
pandemic
disease
infectious.
- 4** Start your search, but be selective. Remember you are trying to find out about the causes and solutions.
- 5** Produce a poster, based on your findings, on a sheet of A3 size paper. Your poster should attempt to explain your findings in a user-friendly way to someone who knew nothing about the disease you have been researching.

Tips on producing a good poster

- Use colour - it makes it more eye-catching.
- Keep it simple - too much detail makes it look untidy and cluttered.
- Stick to a simple message that you want to get across.
- Use large diagrams and drawings so that they can be seen from a distance.

Type	Purpose	Differentiation
Paper	Pupils interpret data to produce a hypothesis. New data forces pupils to re-evaluate their original hypothesis and modify it.	Core Resource 1 Resource 2

Running the activity

Pupils are given Resource 1 and are asked to produce a hypothesis.

They should conclude that the antibiotic is in the red flowers. They are then given a Resource 2, which shows that their original hypothesis was incorrect. They should now conclude that the antibiotic is found in all *Beautiflora* plants that have coloured flowers (red and yellow) and they have to modify their original hypothesis.

Other relevant material

[C6a Resource 1](#) and [Resource 2](#)

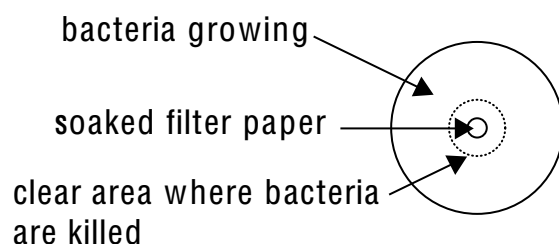
Pupils should be asked to use Resource 1 before seeing Resource 2. They should then use Resource 2.

Answers

- ① flowers
- ② It is a red chemical.
- ③ no
- ④ Only found in *Beautiflora* species and is the colour pigment in the flower.
White flowers have no pigment so no antibiotic.

A research scientist decided to investigate five different plants, to see if they contained a new undiscovered antibiotic. She made an extract from each plant and soaked a small disc of filter paper in each extract. She then placed the filter paper in a Petri dish that had bacteria growing in it. You are going to draw conclusions from her evidence.

If the plant contained a new antibiotic, the dish would look like this.



Look at the data that the scientist collected on Resource 1 and then answer the following questions.

- ① Suggest which part of the plant contains the new antibiotic.
- ② What other hypothesis could you make about the new antibiotic?

Your teacher will then give you Resource 2 to read. Answer the following questions.

- ③ Do these results support your original hypothesis?
- ④ Use the new results to produce a new hypothesis.

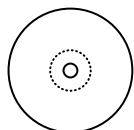
These are the results of her first experiment.

Plant A extract

Red flowers
Small green
leaves
Thick brown
stem

Name

*Beautiflora
impatiens*



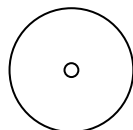
plant A extract

Plant B extract

Yellow flowers
Large green
leaves
Thin brown
stem

Name

*Wondiflora
impatiens*



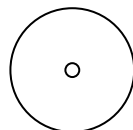
plant B extract

Plant C extract

White flowers
Small green
leaves
Thick green
stem

Name

*Beautiflora
terrifica*



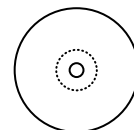
plant C extract

Plant D extract

Red flowers
Large yellow
leaves
Thin green
stem

Name

*Beautiflora
repens*



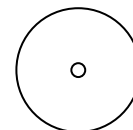
plant D extract

Plant E extract

Yellow flowers
Large yellow
leaves
Thin brown
stem

Name

*Wondiflora
repens*



plant E extract

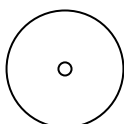
The scientist thought that the antibiotic might be contained in the red pigment in the flower. These were her results from testing the new hypothesis on some more plants.

Plant F extract

White flowers
Large green
leaves
Thick brown
stem

Name

*Wondiflora
parentalis*



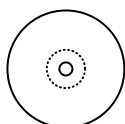
plant F extract

Plant G extract

Red flowers
Small green
leaves
Thick yellow
stem

Name

*Beautiflora
septis*



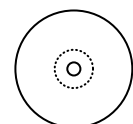
plant G extract

Plant H extract

Yellow flowers
Large yellow
leaves
Thin yellow
stem

Name

*Beautiflora
auralis*



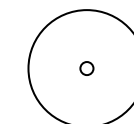
plant H extract

Plant I extract

Red flowers
Small green
leaves
Thick brown
stem

Name

*Wondiflora
magnifica*



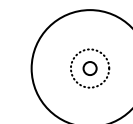
plant I extract

Plant J extract

Red flowers
Small yellow
leaves
Thick green
stem

Name

*Beatiflora
magnifica*



plant J extract

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Word game	Looking ahead
Do a 'What am I?' game for each type of microorganism.	Whole-class feedback on Activity C1a.	Groups of pupils discuss the outcome of calculations in Activity C1c.	In the 'Fast talker' game, pupils name as many things associated with microorganisms as they can.	Looking ahead to C2, pupils suggest how microorganisms can be problematic or even harmful.

Review learning

- Teacher asks pupils 'What am I?' for each type of microorganism and can only give yes or no answers. The first person to correctly identify the microorganism wins one point. If a pupil guesses incorrectly they are out of the game. The pupil with most points at the end of the game is the winner.

Microorganisms

Bacteria, virus, fungi, common cold, mushroom, toadstool, flu, yeast.

Sharing responses

- Short feedback about results from growing microorganisms. Check if all groups manage to grow yoghurt bacteria. Check everyone understands where the microorganisms came from.

Answers

- Food, warmth and water.
- After four hours there would be 4096 bacteria.
- Answers will vary. Some pupils will double the number of yeast cells every hour. Some pupils may realise that growth will slow as resources become scarce.

Group feedback

- In groups, pupils compare their answers to the calculations.

Word game

- Select a pupil to talk about all they know about microorganisms in one minute. If they pause for more than three seconds or repeat any previous information, they are 'out'. Select a new pupil and continue the game until all the important points have been covered.

Looking ahead

- Set the question on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear that they may not know the answer and need to suggest their ideas.
- Suggestions can be summarised and recorded in the pupils' books to then reconsider after further lessons.
- Ideas could include food wastage due to decay, window frames rotting, things going mouldy and diseases.

Question

How can microorganisms be problematic or even harmful?

Investigate: What affects how yeast grows?

Suggested alternative plenary activities (5–10 minutes)

Review learning	Group feedback	Analysing	Evaluating
Teacher-led review of the planning and carrying out of the investigation.	In groups, pupils discuss their findings.	Teacher-led review of the findings of the investigation.	Teacher-led review of how the method could be improved.

Review learning

- Pupils identify the variables in the investigation.
- Pupils say what values they chose for the things they were going to keep the same and for independent variables.

Group feedback

- Pupils work in pairs and use the data they have collected to decide what they can conclude.
- Pupils should state something from their data to justify their decision on the evidence.
- Summarise the responses from all pairs on the board.

Analysing

- Ask pupils what conditions yeast needs for growth. Correct answers will include warmth and food.
- Ask pupils why a control was used.
- Ask pupils how the data could be presented in a more user friendly way, e.g. bar chart.

Evaluating

- Ask pupils to feedback ideas about how they could improve the reliability of their results.

Suggestions

Controlling the temperature more accurately.

A method of measuring the amount of gas in the balloons, e.g. by downward displacement of water.

Ensure that all samples are left for the same amount of time, i.e. not just 20 minutes from the start of setting up the experiment.

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Pupils differentiate between harmful and useful microorganisms.	Pupils use key words to describe how the body protects itself against disease.	Pupils feedback from butcher's shop cartoon.	Pupils brainstorm how to avoid infection from a disease.	Pupils suggest various ways of killing harmful microorganisms.

Review learning

- Pupils work in pairs and have five minutes to prepare five questions. They write one question each on a disease caused by a virus, a bacterium and a fungus, and two questions on different uses for microorganisms. The pupils then challenge other groups, but must be able to answer their own questions.

Sharing responses

- Pupils are given one of the following key words, and then produce an explanation of how the body defends itself against disease by using the key word in the answer.

Key words

stomach acid, tears, earwax, white blood cells, skin, mucus

Group feedback

- Pupils are asked to read out all the health hazards that can be seen in the butcher's shop. As soon as one pupil has run out of ideas, another one takes over until all of the hazards have been reported.
- Then see which group gets the highest score and ask them to present their findings to the rest of the class.

Answers

There are 19 hazards in the picture: wearing jewellery, not wearing hats, long hair, coughing on food, dirty sink, raw meat next to cooked meat, smoking over food, animal in the shop, flies everywhere, spilt stuff on floor/surfaces, no overalls, no gloves, dirty knives lying around, fridge too warm, assistant picking his nose, dirty overalls, dead animal left on counter, toilet door left open, dirty walls and floor.

Produce a leaflet

- Pupils imagine they are going to produce a leaflet to show how to avoid infection from a disease such as AIDS or SARS. Ask them to brainstorm the main ideas or points they would want to include on such a leaflet. Note it is not intended that they actually finalise the text and write the leaflet. This would probably take too long.

Looking ahead

- Set the question on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear that they may not know the answer and need to suggest their ideas.
- Suggestions can be summarised and recorded in the pupils' books to then reconsider after further lessons.
- Pupils may suggest silly ways such as hitting with a hammer, or sensible ways such as using drugs or chemicals.

Question

How could you kill harmful microorganisms?

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Check progress by adding new key words to Unit map.	Whole-class feedback on Activity C3a.	Pupils feedback on Activity C3b.	Pupils identify the creativity in terms of interpreting the evidence in the story of Sir Alexander Fleming.	Ask pupils what they know about MMR and write the list on the board.

Review learning

- Pupils check their progress by adding all new key words so far to the Unit map.

→ *Unit map*

Words

immune system, immune, white blood cells, sexually transmitted disease, antibodies

Sharing responses

- Pupils feedback and share ideas about which was the most effective substance in killing the microorganisms. They should also realise that the blank paper was to act as a control and make it a 'fair test'.

Group feedback

- Pupils feedback ideas about whether doctors should prescribe antibiotics for the common cold.

Brainstorming

- Pupils read the story about Sir Alexander Fleming from the pupil sheet.

They identify, by highlighting with a highlighter pen, the parts of the story that demonstrated creativity in terms of interpreting scientific evidence.

→ *Pupil sheet*

Answers

In 1922 he suddenly realised that tears might contain chemicals to kill microorganisms that enter our eyes.

Instead of throwing the Petri dish away, he suddenly realised that the mould must be producing a chemical that was killing the bacteria near to it.

Looking ahead

- Ask pupils what they know about the MMR vaccine. List all the points from a brainstorming session on the board. All suggestions should be included even when the pupils have misunderstandings about the nature of the MMR vaccine.
- Discuss any misconceptions that pupils might have.

Brainstorming

Read the following story very carefully. It tells how the antibiotic penicillin was first discovered and produced by three scientists. When you have read the story, use a highlighting pen to mark the part of the story where one of the scientists showed creative scientific thinking.

The story of the discovery of the antibiotic called penicillin

Alexander Fleming was born in 1881. He trained as a doctor and worked in a hospital in London. He became interested in studying bacteria and how they could be prevented from causing disease.

In 1922 he suddenly realised that tears might contain chemicals to kill microorganisms that enter our eyes. He went on to discover that tears contain a natural substance that can kill bacteria. One day he was growing some bacteria in a Petri dish. When he looked at the dish he noticed that some mould was also growing on the surface of the agar jelly. This annoyed him because it meant that his experiment with the bacteria had been contaminated with an unwanted mould. It meant he would have to start the experiment all over again.

Before throwing the dish away, he looked at it to see where the mould was growing. He noticed that the bacteria were not growing in an area just around the mould. There was an area around the mould where there were no bacteria. Instead of throwing the Petri dish away, he suddenly realised that the mould must be producing a chemical that was killing the bacteria near to it.

Later, two other scientists called Florey and Chain isolated the chemical that was killing the bacteria and called it penicillin. The miracle drug was used to save the lives of thousands of soldiers who were dying from bacterial infection during World War II.

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Word game	Looking ahead
Check progress by completing the Unit map using new key words.	Whole-class feedback on Activity C4a.	Pupils review each other's presentations from Activity C4b.	Quick 'Millionaire game' based on material in unit so far.	Pupils suggest what we would do and how it would affect our lives if a major new disease struck the UK.

Review learning

- Pupils complete the Unit map by adding any further new key words.

→ [Unit map](#)

Words

hygiene, immunity, vaccination

Sharing responses

Pupils feedback responses from the five questions on C4a about precautions taken when travelling abroad to avoid infection.

Group feedback

- In groups, pupils give short presentations, one from each of the three groups, i.e. Jenner, Snow or Lister.

Word game

- Hand out the pupil sheets. Ask pupils to have a go at answering as many questions as they can. Make it clear that the harder questions are towards the end.
- When pupils have had five minutes to answer the questions, go over the answers with the class.

→ [Pupil sheet](#)

→ [Teacher sheet](#)

Looking ahead

- Set the question on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear that they may not know the answer and need to suggest their ideas.
- Suggestions can be summarised and recorded in the pupils' books to then reconsider after further lessons.
- Links could be made to the SARS or AIDS virus.

Question

What we would do and how would it affect our lives if a major new disease struck the UK?

Word game

£	Question	Answer
100	What are microscopic organisms called?	
500	What is the smallest kind of microscopic organism?	
1000	Who discovered the cause of cholera?	
5000	What chemicals can be used to kill bacteria on the surface of our skin?	
10 000	What do the letters MMR stand for?	
50 000	If a single bacterium divides every 20 minutes, how many bacteria will there be after four hours?	
100 000	How did Sir Alexander Fleming demonstrate creative interpretation of scientific evidence?	
500 000	Who discovered the first vaccine?	
1 000 000	The word <i>vacca</i> means 'cow'. Suggest where the word vaccination comes from?	

Word game

£	Question	Answer
100	What are microscopic organisms called?	
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Word game

£	Question	Answer
100	What are microscopic organisms called?	microorganisms
500	What is the smallest kind of microscopic organism?	virus
1000	Who discovered the cause of cholera?	Dr Snow.
5000	What chemicals can be used to kill bacteria on the surface of our skin?	antiseptics
10 000	What do the letters MMR stand for?	Measles, mumps and rubella.
50 000	If a single bacterium divides every 20 minutes, how many bacteria will there be after four hours?	4096
100 000	How did Sir Alexander Fleming demonstrate creative interpretation of scientific evidence?	He realised that the mould was producing a chemical to kill the bacteria in his Petri dish.
500 000	Who discovered the first vaccine?	Jenner
1 000 000	The word <i>vacca</i> means 'cow'. Suggest where the word vaccination comes from?	Cowpox was first vaccine.

Suggested alternative plenary activities (5–10 minutes)

Review learning	Sharing responses	Group feedback	Brainstorming	Looking ahead
Wordsearch on modern control methods, chlorination, boiling, immunisation, antibiotics.	One pupil from each group feeds back what they would have done in Activity C5a.	Pupils share the results of their Internet search in Activity C5b.	Pupils suggest what difficulties scientists might have finding new medicines and how they might go about doing it.	Pupils revise and consolidate knowledge from the unit.

Review learning

- Ask pupils to complete the wordsearch on the pupil sheet.
- Ring the words on a copy of the pupil sheet and show it as an OHT for them to check their answers. Use the words on it to sum up the lesson.

→ [Pupil sheet](#)

Share responses

- One representative from each group feeds back their thoughts about what their group would have done in the Eyam scenario.
- Discuss their thoughts and the merits of each solution.

Group feedback

- In groups, pupils look at the posters resulting from their Internet search. Suggest they comment on any new or interesting facts they have found.

Brainstorming

- Set the questions on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear that they may not know the answer and need to suggest their ideas.
- Suggestions can be summarised and recorded in the pupils' books to then reconsider after further lessons.

Questions

How would you identify a potential new drug?

Where might you find new drugs?

How would you test the drug to ensure that it was safe to use on people?

Looking back

- Pupils revise and consolidate knowledge from the unit. They can use the Unit map, Pupil checklist, or the Test yourself questions.

→ [Unit map](#)

→ [Pupil checklist](#)

→ [Test yourself](#)

Review learning

All these words are connected with modern methods of controlling microorganisms. See how many of them you can find in the wordsearch.

antibiotic

antiseptic

bleach

boil

chlorinate

disinfect

immunise

sterilise

A	N	T	I	S	E	P	T	I	C	A
C	E	T	A	N	I	R	O	L	H	C
E	S	V	E	S	I	N	U	M	M	I
Q	I	I	B	P	W	J	G	A	O	T
U	L	P	F	U	I	B	B	Y	H	O
K	I	L	B	X	N	L	O	G	F	I
A	R	M	D	W	Q	E	I	X	N	B
T	E	R	C	C	O	A	L	B	J	I
E	T	J	R	G	Z	C	H	K	E	T
L	S	Z	I	H	I	H	M	Y	P	N
T	D	I	S	I	N	F	E	C	T	A

Suggested alternative plenary activities (5–10 minutes)

Group feedback	Bridging to other topics
Pupils discuss the implications of jumping to conclusions and hypothesis testing.	The idea of the structure of the Solar System.

Group feedback

- Pupils discuss the implications of jumping to conclusions and how this could be dangerous when choosing new medicines. Ask pupils to explain how a hypothesis needs to be constantly tested as more evidence becomes available.

Bridging to other topics

- Ask pupils to put the following ideas into their correct order, starting with the first hypothesis and ending with modern day theory. Pupils could then be asked if this is the final hypothesis or could there be more to come.

Ideas

The Sun is one of many stars in the sky.

The Earth and other planets go round the Sun.

The Sun goes round the Earth.

The Universe is expanding.

1 Match the words to the descriptions.

Louis Pasteur

Another name for microorganisms.

microorganisms

Yeast is a single-celled one.
Some are made of long threads.

microbes

Showed, in 1881, that food goes bad
because 'germs' we can't see land on it.

bacteria

The proper name for the tiny living
things sometimes called 'germs'.

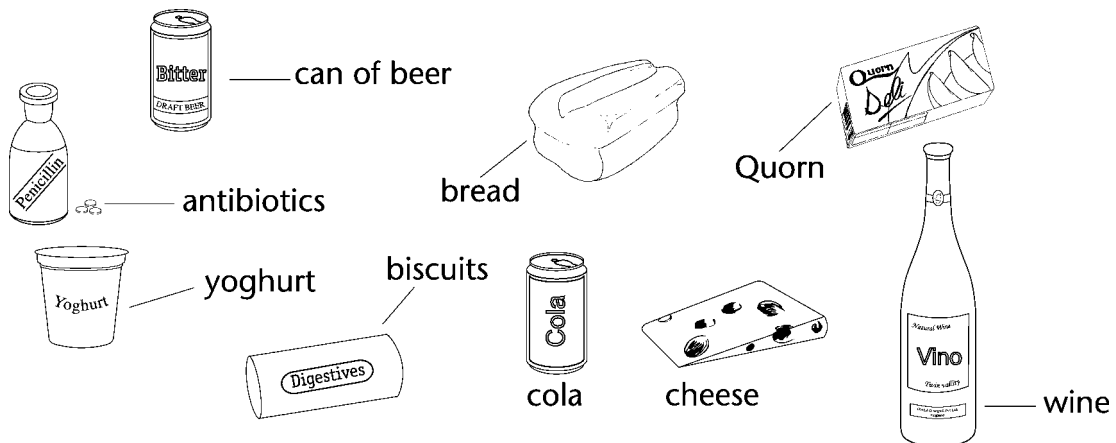
viruses

Single-celled organisms.

fungi

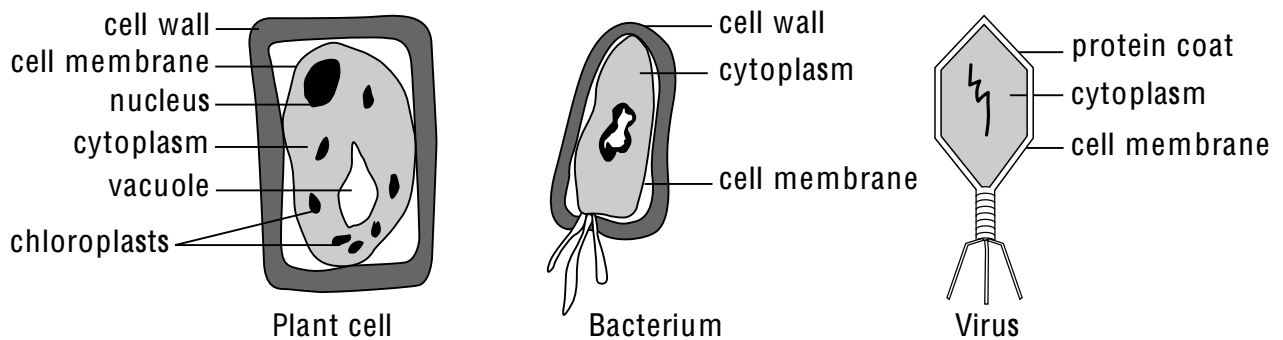
Smaller than bacteria. They are not
made of cells.

2 Here are some products.



- a** Find the products that are made using fungi.
Colour them green.
- b** Find the products that are made using bacteria.
Colour them blue.
- c** Find the products that are made without using
bacteria or fungi. Colour them red.

- 3** Look at the pictures. They show a plant cell, a bacterium and a virus.



- a** Fill in this table with ticks (✓) and crosses (X).

Feature	Plant cell	Virus	Bacterium
Nucleus			
Cytoplasm			
Cell wall			
Cell membrane			
Chloroplasts			
Vacuole			
Protein coat			

- b** Which features do both plant cells and bacteria have?

.....

- c** What does a plant cell have that a bacterium does not have?

.....

- d** What does a virus have that plant cells and bacteria do not have?

.....

- e** What is the same about a bacterium and a virus?

.....

1 Use some of these words to fill in the gaps.

pathogens

white

microbes

microscopes

insects

infections

disease

red

- a** Many are harmless. Some can cause or if they get inside my body.
- b** Microbes that cause disease are called
- c** My blood cells help fight the microbes that cause disease.

2 Look at this list of diseases.

ringworm

'flu

tetanus

food poisoning

AIDS

colds

TB

athlete's foot

- a** Find the diseases caused by bacteria. Colour them red.
- b** Find the diseases caused by viruses. Colour them blue.
- c** Find the diseases caused by fungi. Colour them green.

3 Look at this table. Use ticks (✓) and crosses (X) to fill it in.

	Keeps bacteria out of my body	Ways bacteria can get into my body
A cut in my skin.		
I breathe in air containing microbes.		
My skin is a good barrier.		
The water I drink and the food I eat.		
Unprotected sexual intercourse.		
A chemical in tears that can kill bacteria.		
Animal bites.		

4 Here are some sentences about preventing disease. Cut them out, match the beginnings and endings, and stick them down.

After going to the toilet I should wash my hands to stop droplets of water containing microbes going into the air for someone else to breathe in.
I should cover my nose and mouth when I sneeze to stop microbes in the blood of one person getting into the blood of the other.
Medicine users should not share syringes (needles) to stop microbes getting onto my food.

- 1 Draw lines to match each substance to what it does.
You need to use one substance twice!

antibiotics



antiperspirant



antiseptics



chlorine



cooking



disinfectants



sterilising solution



toothpaste



Put on cuts to kill bacteria that get into them. Joseph Lister discovered the first one used. It made it safer to have an operation.

Medicines that kill bacteria but not viruses.

Alexander Fleming made the first one, called penicillin.

Kills bacteria in drinking water.

Kills bacteria that cause body odour.

Kills bacteria in babies bottles.

Kills the bacteria that cause tooth decay.

Kills the bacteria on food.

Kills bacteria on floors, sinks and toilets.

2 Write *true* or *false* for each sentence.

- a** Joseph Lister discovered penicillin.
- b** Colds and 'flu are caused by viruses.
- c** Colds and 'flu can be treated with antibiotics.
- d** Joseph Lister discovered the first antiseptic.
- e** Penicillin is made from a mould.

3 Look at these diseases.

food poisoning

cold

'flu

tetanus

whooping cough

German measles

rabies

AIDS

tuberculosis (TB)

chicken pox

Make a list of the diseases that can be treated by antibiotics.

.....

.....

1 Use words from this list to fill in the gaps.

immune

antibodies

vaccination

smallpox

immunised

- a** An injection of dead microbes into your body so that you make antibodies is called
- b** If the live microbes infect your body, the are ready to fight them. You have been You won't get the disease because you are now to it.
- c** has been wiped out completely all over the Earth, thanks to vaccination.

2 Edward Jenner made an important discovery. Here is the story of his discovery. The story is all muddled up! Cut each box out. Put them in order. When you're sure, stick them down.

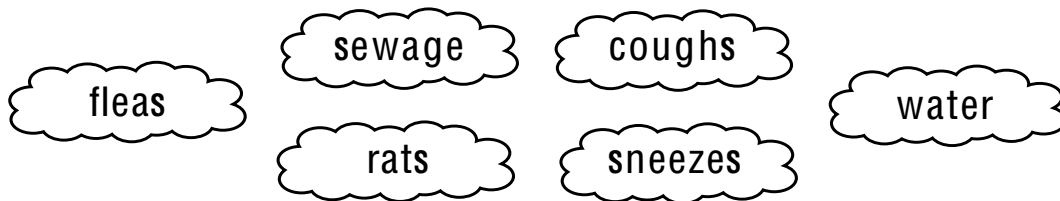
a Edward Jenner took some pus from some cowpox sores on a milkmaid's hands.

b Edward Jenner called his discovery vaccination.

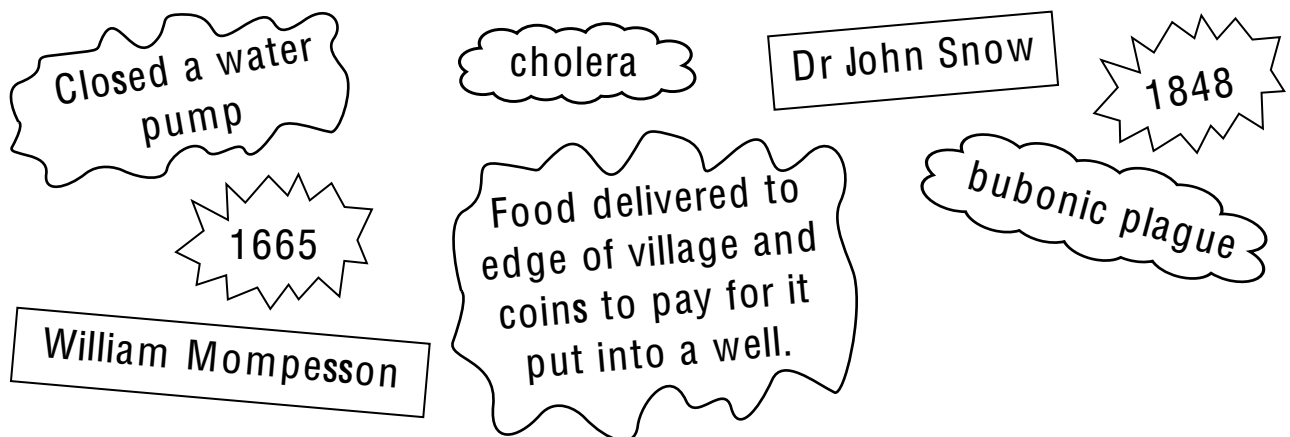
c Edward Jenner put some pus from smallpox sores into James Phipps. James didn't get smallpox.

d Edward Jenner put the pus from the cowpox into James Phipps. James got cowpox, and he got better quickly.

- 1 These sentences are about two diseases - bubonic plague and cholera. Use these words to fill in the gaps.



- a The bacterium that causes bubonic plague lives in
- b bite the rats and then bite people, who get the disease.
- c Bubonic plague was passed on from person to person by and
- d Cholera is caused by a bacterium that lives in
- e The bacterium that causes cholera comes from
- 2 Link together the person, the disease, the year and how they stopped the disease from spreading.



- 3 Write *true* or *false* for each sentence.
- a Bubonic plague cannot be treated by antibiotics.
- b Adding chlorine to water kills the cholera bacterium.
- c Boiling water stops the spread of bubonic plague.
- d Immunisation can prevent outbreaks of cholera.

- 1 These sentences are about how new medicines are designed. But they are all mixed up! Write numbers in the boxes to put the sentences in order.

If the medicines pass the tests, then doctors can give them to patients that need them.

New medicines are first tested on animals.

Scientists look at what causes the disease and how it affects the body.

Human volunteers test the medicines.

They get clues about what may help treat the disease.

- 2 Draw lines to match the words to the correct meanings.

medicine

A tablet that doesn't contain any medicine.

placebo

A link between the patient taking a medicine and the patient getting better.

correlation

Something that can be used to treat a disease.

- 3 The table shows the results of tests on two new medicines.

	Given new medicine A	Given new medicine B	Given a placebo
Got better	17	6	4
Didn't get better	3	14	16

Cross out the wrong words. Underline the right words.

- a** Medicine A *does* / *does not* work because *more* / *less* people got better using it.
- b** Medicine B *does* / *does not* work because *more* / *less* people got better using it.

C1 Going on growing

- 1 Louis Pasteur – Showed, in 1881, that food goes bad because ‘germs’ that we can’t see land on it.
microorganisms – The proper name for the tiny living things sometimes called ‘germs’.
microbes – Another name for microorganisms.
bacteria – Single-celled organisms.
viruses – Smaller than bacteria. They are not made of cells.
fungi – Yeast is a single-celled one. Some are made of long threads.
- 2 a Coloured green – antibiotics, bread, cheese, Quorn, beer, wine
b Coloured blue – yoghurt
c Coloured red – biscuits, cola

3 a

Feature	Plant cell	Virus	Bacterium
nucleus	✓	✗	✗
cytoplasm	✓	✓	✓
cell wall	✓	✗	✓
cell membrane	✓	✓	✓
chloroplasts	✓	✗	✗
vacuole	✓	✗	✗
protein coat	✗	✓	✗

- b cytoplasm, cell wall, cell membrane
c nucleus, chloroplasts, vacuole
d protein coat
e cytoplasm, cell membrane

C2 Defence systems

- 1 a microbes, disease, infections
b pathogens c white
- 2 a Coloured red – food poisoning, TB, tetanus
b Coloured blue – AIDS, ‘flu, colds
c Coloured green – ringworm, athlete’s foot

3

	Keeps bacteria out of my body	Ways bacteria can get into my body
A cut in my skin.	✗	✓
I breathe in air containing microbes.	✗	✓
My skin is a good barrier.	✓	✗
The water I drink and the food I eat.	✗	✓
Unprotected sexual intercourse.	✗	✓
A chemical in tears that can kill bacteria.	✓	✗
Animal bites.	✗	✓

- 4 After going to the toilet I should wash my hands ... to stop microbes getting onto my food.
I should cover my nose and mouth when I sneeze ... to stop droplets of water containing

microbes going into the air for someone else to breathe in.

Medicine users should not share syringes (needles) ... to stop microbes in the blood of one person getting into the blood of the other.

C3 Killing bacteria

- 1 antibiotics – Medicines that kill bacteria but not viruses. Alexander Fleming made the first one, called penicillin.
antiperspirant – Kills bacteria that cause body odour.
antiseptics – Put on cuts to kill bacteria that get into them. Joseph Lister discovered the first one used. It made it safer to have an operation.
chlorine – Kills bacteria in drinking water.
cooking – Kills the bacteria on food.
disinfectants – Kills bacteria on floors, sinks and toilets.
sterilising solution – Kills bacteria in babies’ bottles.
toothpaste – Kills the bacteria that cause tooth decay.
- 2 a false c false e true
b true d true
- 3 food poisoning, tetanus, tuberculosis, whooping cough

C4 Fighting infection

- 1 a vaccination
b antibodies, immunised, immune
c smallpox
- 2 a, d, c, b

C5 The battle goes on

- 1 a rats c coughs, sneezes e sewage
b fleas d water
- 2 William Mompesson – bubonic plague, 1665, food delivered to edge of village and coins to pay for it put into a well
Dr John Snow – cholera, 1848, closed a water pump
- 3 a false b true c false d true

C6 Testing medicines

- 1 5, 3, 1, 4, 2
- 2 medicine – Something that can be used to treat a disease.
placebo – A tablet that doesn’t contain any medicine.
correlation – A link between the patient taking a medicine and the patient getting better.
- 3 a Medicine A *does* work because *more* people got better using it.
b Medicine B *does not* work because *less* people got better using it.

HELP

- 1 Match each different microbe to its correct description and write the correct sentences.

Bacteria

are not made of cells and are very small.

Viruses

can be small round cells or made of long threads.

Fungi

are small cells with a cell wall but no nucleus.

- 2 Link all the words in List A with the things they do in List B. Write them out in full sentences.

List A

yeast

antibiotics

fungi

mould

bacteria

List B

are used to make Quorn.

grows on stale bread.

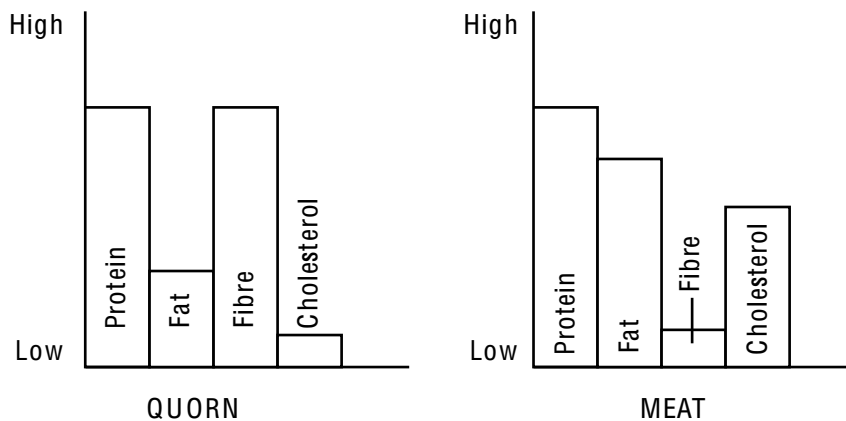
makes bread rise.

are used to make yoghurt.

can be made from moulds.

CORE

- 3** A bacterium causes whooping cough in children.
- Explain why it is not possible to see this bacterium.
 - Describe two other features of the bacterium.
 - How does the bacterium reproduce?
- 4** These bar charts show the contents of animal meat and Quorn.



- Explain why Quorn is often described as 'a healthy alternative to meat'.
- When these new fungi-based proteins were developed, they were tested for at least ten years before they were sold. Explain why such a long time for testing was necessary.

EXTENSION

- 5 a** Natalie counted the bacteria in some milk left in a warm place. The number of bacteria doubled every 30 minutes. Copy and complete the results chart below.

Time (hours)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Number of bacteria	1	2	4	8							

- Draw a graph of Natalie's results on graph paper. Put time on the horizontal (x) axis and number of bacteria on the vertical (y) axis.
 - Describe the relationship between the rate at which bacteria increase and time.
 - Each bacterium divides every 30 minutes. Explain why the graph is not a straight line.
 - Why would it be very hard to use this type of graph to estimate the number of bacteria in Natalie's milk after 24 hours?

HELP

- 1** The list below contains some common illnesses. Write down each illness and explain how you might catch it.

cold

AIDS

athlete's foot

food poisoning

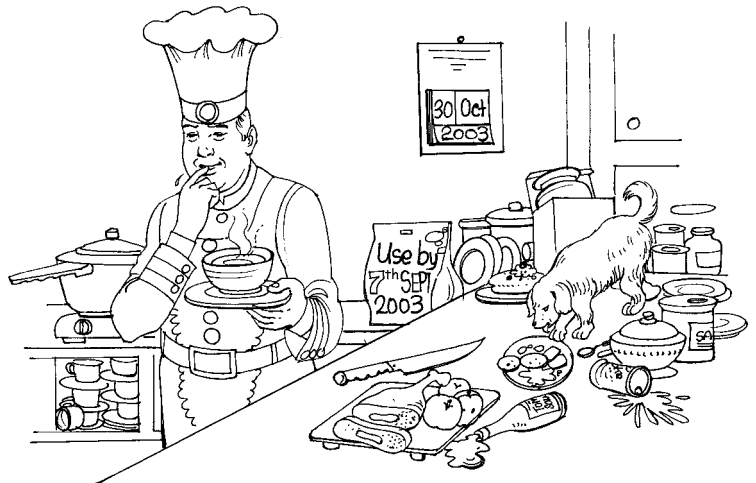
tetanus

- 2 a** Which special blood cells can swallow up microbes?
- b** Copy and complete the following sentences:
- i** An antibody is a chemical that can ...
 - ii** You should always wash your hands after using the toilet because ...

CORE

- 3** Barry caught chicken pox when he was very young. Explain why he has not caught it again.

- 4 a** Look at this picture. List **five** things that might spread disease.
- b** The chef has a tummy upset. He never leaves the kitchen. Explain how his tummy upset might be transmitted to a restaurant customer.



EXTENSION

- 5** New mothers are advised to breast feed their babies for several months. Explain why this is good advice.
- 6** Describe the three ways that white blood cells help to prevent you from becoming ill.
- 7** Sam, aged 14, moved to a new house in a different part of the country. For the first few months he seemed to catch a different illness every few weeks. He could not remember being ill so often at his old house. Suggest reasons why he caught so many illnesses after he moved house.

HELP

- 1 This list gives several ways in which bacteria can be killed.

disinfectant

sterilizing

antiseptic

antibiotic

adding chlorine

heating thoroughly

Copy and complete the table, using the words above.

Source of bacteria	Best way to kill the bacteria
Tap water	
Raw chicken	
Cut finger	
Surgeon's scalpel	
Infection in your blood	
Kitchen waste bin	

- 2 Sita caught a virus that gave her polio. Akpata caught a bacterium that gave her pneumonia. They both took antibiotics.

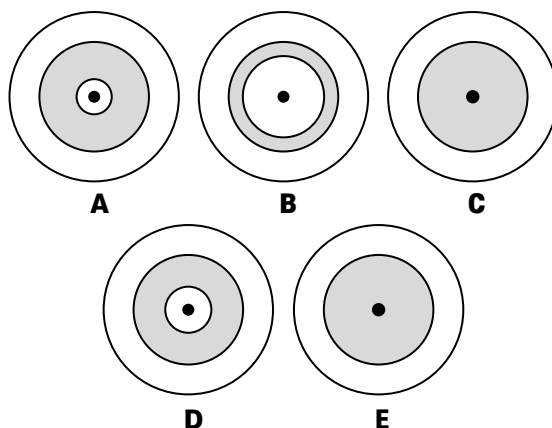
Copy and complete these sentences:

- a Sita stayed ill because ...
- b Akpata quickly got better because ...

CORE

- 3 Dr Fleming's patient, Joan, had a lung infection. Dr Fleming sent samples of her phlegm to the hospital laboratory. In the lab, the scientists grew the bacteria on agar plates. In the middle of each plate they put one drop of antibiotic solution. They used a different antibiotic on each plate.

Look at the diagrams. They show the lab results after two days. The spots show where the antibiotic drop was put. The shaded areas show where bacteria have grown.



- a** Which antibiotics could Dr Fleming prescribe for his patient?
- b** Which antibiotic would be best?
- c** Which antibiotics should Dr Fleming avoid?
- d** Joan is allergic to antibiotic B but not to the others. It causes a very itchy rash all over her body. Normally it is given as a course of tablets lasting for seven days.
 - i** Which antibiotic should Dr Fleming use instead?
 - ii** Why will Dr Fleming prescribe a 14-day course of this antibiotic?
 - iii** What would Dr Fleming have done if he only wanted Joan to take the tablets for seven days?
- e** Joan went to a family party, the day after she first became unwell. Four members of her family became ill a few days later. Explain how they became ill.

EXTENSION

- 4** Animals that are reared in intensive farming conditions often have feeds containing low doses of antibiotics, which make them grow faster.
 - a** Other than growth, why might it be necessary to add antibiotics to feedstuff for intensive farming?
 - b** Doctors are finding that some bacteria are becoming harder to destroy. Explain how adding antibiotics to animal feed might be an important factor in this problem.
- 5** In 2003, a new illness called the SARS (severe acute respiratory syndrome) virus appeared in China. It quickly spread to most of the Far East and also appeared in Canada. Many people became ill and some died.
 - a** Hospitals did not prescribe antibiotics to SARS patients. Explain why not.
 - b** Television pictures from infected areas showed people wearing medical facemasks in towns and at work. Why did they think this would help?
 - c** Most people who caught SARS eventually got better. Why are they unlikely to catch SARS again?
 - d** What would hospitals do to try to make sure that a SARS patient did not infect everyone else?
 - e**
 - i** Some diseases, like AIDS, can be helped by prescribing antiviral drugs. How can antiviral drugs help?
 - ii** Why don't doctors prescribe antiviral drugs for colds and 'flu?

HELP

- 1** Match the words with the definitions below to write a correct meaning for each word.

antibodies

immunity

inoculation

vaccination

- injecting live microbes into your body.
 - having enough antibodies inside you to prevent an illness.
 - injecting dead or inactive microbes into your body.
 - chemicals that make it easier for white blood cells to kill microbes.
- 2 a** Janet had chickenpox when she was five years old. Now her younger brother has it. Explain why Janet will not become ill.
- b** Chickenpox does not kill people. Why don't we vaccinate people against chickenpox?
- c** Why is smallpox now an extinct illness?

CORE

- 3** Look at the information in the table on sheet 3 about childhood illnesses.
- a** Lucy is going to Africa for her family holiday. Her doctor advises her to get vaccinated before she goes. For which diseases has Lucy probably already been vaccinated?
 - b**
 - i** Which other diseases would it be sensible to be vaccinated for, before she goes to Africa?
 - ii** Why has Lucy not been vaccinated against these diseases before?
 - c** Two of the diseases are usually protected against in a single vaccination, in the UK. This also protects against a third childhood illness. What is the third illness?
(*Hint: ask an adult at home what MMR stands for.*)
 - d** For one of the diseases in the table a vaccination is not possible. Which one?

EXTENSION

- 4** Look at the table given for question 3. Yellow fever protection is given using a weakened live vaccine. The other immunisable diseases are given as an injection of ready-made antibodies.
- a** What kind of immunity is provided by the yellow fever vaccine?
 - b** Why are regular booster injections needed for the other vaccines?
 - c** Typhoid is a serious gut illness causing high fever, delirium, dehydration and possible death. It is common in areas of poor water hygiene and is spread by drinking contaminated water, or by eating food that has been washed in contaminated water. The typhoid vaccination must be repeated every three years. What does this tell you about:
 - i** the type of immunity given by the vaccine?
 - ii** what is in the vaccine?
 - d** Why is the typhoid vaccine not routinely given in the UK?
- 5**
- a** Explain why inoculation with a live vaccine usually gives better and longer protection than vaccination with ready-made antibodies.
 - b** Why are live vaccines more likely than other vaccines to make you feel 'off colour' for a few days?

CORE

Illness	Symptoms and effects	Transmission	Where found	How often caught?
Chickenpox	Itchy spots and mild fever for 10-14 days. Good recovery	Contact with infected person	International	Once
Rubella	Rash and slight fever. Can cause brain damage to unborn babies	Contact with infected person	International	Usually once
Mumps	Painful swellings in neck and groin. Can cause sterility in adult men	Contact with infected person	International	Once
Yellow fever	Fever/head and stomach pain/vomiting. Potentially fatal	Mosquito bites	All hot countries, especially Africa and India	Once
Tetanus	Muscle paralysis. Potentially fatal	From soil and animal dung	International	Once
Malaria	Fever and shivering. May cause death if not treated in time	Mosquito bites from a mosquito carrying the parasite	Tropical areas, especially Africa	From every infected bite
Meningococcal meningitis	Fever. Inflammation of brain tissue. Potentially fatal	Coughs and sneezes from infected people	International	Once

Read the information below.

HELP

It is Monday morning at the Public Health Laboratory. Susan answers the phone. It is a call from Dr Bugg, at one of the two health centres in town.

"I think we have a problem", he says. "I've had five patients in this morning who have sickness and diarrhoea. It looks like food poisoning. They all went to a party at Grubb's restaurant yesterday, and they all had prawns for starters. There were forty people at the party, so I expect I will have more in before the day is out."

"Thank you, doctor", replies Susan. "Leave it with us. I will get to work straight away."

"I've taken some faeces (poo) samples", says the doctor. "Not very pleasant! I'll send them straight over. Good luck."

Susan sends her assistant, Jody, to Grubb's restaurant.

When the faeces samples arrive Susan puts the samples onto agar plates and leaves them in the incubator. She puts a drop of antibiotic onto one plate from each patient. She uses several different types of antibiotic. Now all she can do is wait.

Whilst she is waiting, Susan picks up the telephone and rings the other health centre in town.

1 Copy and complete the sentences below:

- a Dr Bugg thought there might be food poisoning in town because ...
- b Dr Bugg's five patients had all eaten ...
- c The number of people who might get food poisoning is ...
- d Dr Bugg took a faeces sample from each patient so that ...
- e Susan now has to wait because ...

CORE

- 2 a** Describe how Susan will have set up the agar plates. Assume that she already has the plates ready for the samples.
- b** What will Susan see on the plates, if the patients have bacterial food poisoning?
- c** How will Susan know, from the plates, that the food poisoning all came from the same infected source?
- d** What material does Jody hope to bring back from Grubb's restaurant?
- e i** What will Susan do with Jody's samples?
- ii** How will this help to confirm that Grubb's restaurant is the source of the food poisoning?

EXTENSION

- 3 a** After Susan has put the first set of agar plates into the incubator, she telephones the other health centre. Why?
- b** Next, Susan telephones Grubb's restaurant. She tells Mr Grubb that Jody is on her way and asks for the name and telephone number of the organiser of yesterday's party. Then she telephones the organiser.
- i** What information does Susan get from the party organiser?
- ii** What does she do when she has this information?
- c i** Why did Susan put drops of different antibiotics onto an agar plate from each patient?
- ii** Who will she contact when she has examined the incubated agar plates and what information will she be able to give them?
- d** How will Susan know that the food poisoning outbreak is under control?

HELP

Question	Answer	Mark
1	Bacteria are small cells with a cell wall but no nucleus.	1
	Viruses are not made of cells and are very small.	1
	Fungi can be small round cells or made of long threads.	1
	<i>2/3 correct = 2 marks; 1 correct = 1 mark.</i>	
2	Yeast makes bread rise, fungi are used to make Quorn, mould grows on stale bread, bacteria are used to make yoghurt, antibiotics can be made from moulds.	5
Total for Help		8

CORE

Question	Answer	Mark
3 a	They are very small. <i>Accept equivalent answers.</i>	1
	b Two from: single cells/have a cell wall/have no nucleus.	2
	c Cells divide.	1
4 a	Has less fat	1
	low in cholesterol	1
	has more fibre	1
	plus more information about one of the above.	1
	b To make sure they were safe for humans to eat.	1
Total for Core		9

EXTENSION

Question	Answer												Mark																								
5 a	<table><tr><td>Time (hr)</td><td>0</td><td>0.5</td><td>1</td><td>1.5</td><td>2</td><td>2.5</td><td>3</td><td>3.5</td><td>4</td><td>4.5</td><td>5</td></tr><tr><td>Number of bacteria</td><td>1</td><td>2</td><td>4</td><td>8</td><td>16</td><td>32</td><td>64</td><td>128</td><td>256</td><td>512</td><td>1024</td></tr></table>												Time (hr)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	Number of bacteria	1	2	4	8	16	32	64	128	256	512	1024	
	Time (hr)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5																									
	Number of bacteria	1	2	4	8	16	32	64	128	256	512	1024																									
	Deduct 1 mark for each error up to two errors.												2																								
	b i	Appropriate scales												1																							
		labelled axes including units												1																							
		accurate plots (to within 10)												1																							
		single line, smooth curve.												1																							
	ii	Rate of growth increases as time increases.												1																							
	iii	As times progresses there are more bacteria dividing so rate of growth ‘takes off’. <i>Accept equivalent answers.</i>												1																							
												1																									
iv	Could not fit the very large numbers onto the scale.												1																								
Total for Extension													10																								

HELP

Question	Answer	Mark
1	Cold – from someone sneezing/by breathing in the virus.	1
	Athlete's foot – from wet floors at swimming pools etc.	1
	Food poisoning – eating contaminated/poorly cooked food.	1
	AIDS – unprotected sex with an infected person.	1
	Tetanus – through a cut in the skin/from soil.	1
	<i>Accept equivalent or other correct answers.</i>	
2 a	White blood cells.	1
b i	An antibody is a chemical that can <u>recognise and fight one type of microbe</u> . <i>Underscores are pupil responses. Other text is copied. Accept equivalent or alternative correct answers.</i>	1
ii	You should always wash your hands after using the toilet because <u>microbes on your hands could be spread to other people on food</u> . <i>Underscores are pupil responses. Other text is copied. Accept equivalent or alternative correct answers.</i>	1
Total for Help		8

CORE

Question	Answer	Mark
3	Antibodies to the virus	1
	chickenpox made in the blood	1
	which can attach to the chickenpox virus and kill it	1
	so he is immune to the disease.	1
4 a	Food past its use by date; meat left out attracts flies; fruit and meat on same chopping board; dog with paws on table used to prepare food; chef tasting the soup with his finger. <i>Accept other sensible answers.</i>	5
b	The chef might: use the toilet and not wash his hands bacteria <i>or</i> viruses <i>or</i> microbes transferred to the food diners eat the food so eating the microbes. <i>Accept equivalent answers.</i>	1 1 1
Total for Core		12

EXTENSION

Question	Answer	Mark
5	Breast milk contains antibodies from the mother	1
	that are transferred to the baby	1
	so baby gets protection/immunity from some diseases.	1
6	Engulf microbes	1
	produce antibodies to microbes	1
	destroy toxins produced by microbes.	1
7	Cold caused by a virus	1
	viruses can change	1
	Sam not immune to the viruses where he moved to	1
	less able to fight off infection.	1
Total for Extension		10

HELP

Question	Answer		Mark
1	Source of bacteria	Best way to kill the bacteria	
	Tap water	Chlorine	1
	Raw chicken	Heating well	1
	Cut finger	Antiseptic	1
	Surgeon's scalpel	Sterilising	1
	Infection in your blood	Antibiotic	1
	Kitchen waste bin	Disinfectant	1
	2 a	Sita stayed ill because <u>antibiotics do not affect viruses</u> . <i>Underscores are pupil responses. Other text is copied.</i>	
b	Akpata quickly got better because <u>antibodies kill bacteria</u> . <i>Underscores are pupil responses. Other text is copied.</i>		1
Total for Help			8

CORE

Question	Answer	Mark
3 a	A, B and D.	1
b	B	1
c	C and E.	1
d i	A or D.	1
ii	Not as good at killing bacteria, so needs more time to do it.	2
iii	Doctor prescribed a stronger dose.	1
e	She breathed <i>or</i> coughed <i>or</i> sneezed near them; droplets containing the bacterium got into the air; the other people breathed them in.	3
Total for Core		10

EXTENSION

Question	Answer	Mark
4 a	To stop infection spreading to all the animals.	1
b	They control a wider range of infections.	1
c	Bacteria build up a resistance to the antibiotics so the antibiotics won't work when used on humans.	1 1
5 a	SARS virus not killed by antibiotics.	1
b	Virus probably spread via droplets in the air mask helps to prevent breathing in the droplets.	1 1
c	Developed antibodies to the virus/built up immunity.	1
d	Disinfect everything/everywhere the patient has been keep the patient in isolation/away from other people.	1 1
e i	Relieve symptoms; prevent the virus from reproducing; boost the immune system.	3
ii	No need as the patient gets better anyway and the illness does not usually cause death <i>or</i> a serious problem.	1 1
Total for Extension		15

HELP

Question	Answer	Mark
1	Vaccination – injecting dead or inactive microbes into your body.	1
	Immunity – having enough antibodies inside you to prevent an illness.	1
	Inoculation – injecting live microbes into your body.	1
	Antibodies – chemicals that make it easier for white blood cells to kill microbes.	1
2 a	She has built up immunity to chickenpox already <i>or</i> already has the antibodies to destroy chickenpox.	1
b	It is not a serious enough disease.	1
c	Vaccination worldwide means that no one catches it now so the microbe has disappeared.	1
		1
Total for Help		8

CORE

Question	Answer	Mark
3 a	Rubella	1
	Mumps	1
	Tetanus.	1
b i	Yellow fever	1
	(Meningococcal) meningitis.	1
ii	Do not occur or uncommon in the UK.	1
c	Measles	1
d	Malaria	1
Total for Core		8

EXTENSION

Question	Answer	Mark
4 a	Active immunity.	1
	Body did not produce the antibodies so the effect wears off.	1
c i	It is passive immunity.	1
	Dead microbes or inactive microbes.	1
	No typhoid in the UK/good water hygiene in the UK.	1
5 a	Antibodies made in own cells	1
	which can now respond quickly if needed in the future.	1
b	You are actually given a small dose of the illness	1
	and you have not yet got the antibodies to fight it.	1
Total for Extension		9

HELP

Question	Answer	Mark
1 a	Dr Bugg thought there might be food poisoning in town because <u>five patients had come in with the same symptoms/five patients had been to the same party.</u> <i>Underscores are pupil responses. Other text is copied. Accept equivalent answers.</i>	1
b	Prawns	1
c	40	1
d	The lab could see if they contained bacteria.	1
e	It takes time for the bacteria to grow.	1
Total for Help		5

CORE

Question	Answer	Mark
2 a	Use a sterile wire spread faeces across the agar plates label each plate seal with a sellotaped-on lid.	1 1 1 1
b	Growths/colonies of bacteria.	1
c	All the same sort of bacteria.	1
d	Some of yesterday's prawns.	1
e i	Make an agar plate with the prawns.	1
ii	Should grow the same sort of bacteria.	1
Total for Core		9

EXTENSION

Question	Answer	Mark
3 a	To see if they have any food poisoning cases.	1
b i	Names <i>or</i> addresses <i>or</i> telephone numbers of everyone at the party.	1
ii	Contacts them to see if they are ill/to find out if they had prawns.	1
c i	To see which antibiotics worked best.	1
ii	The doctors <i>or</i> health centres to tell them which antibiotic to prescribe.	1 1
d	No more new cases reported.	1
Total for Extension		7

1 Complete these sentences by crossing out the wrong words.

a Viruses are **larger/smaller** than bacteria and are not made of cells.

b **Bacteria/viruses** are single-celled organisms with a cell wall but no nucleus.

c **Fungi/bacteria** may be round or made from long threads.

2 Bacteria and fungi have many uses. Draw lines to match each product to the microbe which produces it.

wine Quorn bread yoghurt cheese antibiotics

bacteria

fungi

3 Draw lines to match these organisms to their diseases.

Organism

bacteria ●

virus ●

fungi ●

Disease

● athlete's foot

● food poisoning

● flu

4 Complete these sentences by choosing from the words below. You may use words once, more than once or not at all.

bites

harmful

antibodies

resistant

white

cuts

immune

a The skin keeps out microbes as long as it has no in it.

b Food and water can contain microbes.

c Animals and insects can spread disease if you get from them.

d If microbes get into the blood, they are eaten by blood cells.

e Some white blood cells make that help destroy microbes.

f Antibodies recognise and fight microbes, which makes you to diseases.

5 Tick the diseases that can sometimes be cured by using an antibiotic.

☐

flu

☐

athlete's foot

☐

tuberculosis

☐

chicken pox

6 Complete the story about penicillin using the words below.

antibiotic

bacteria

cure

penicillin

The first was discovered by Sir Alexander Fleming.

He realised that a mould was killing some on an agar plate. Fleming named the antibiotic Later this chemical would be used to bacterial infections.

7 Complete the sentences by crossing out the wrong words.

- a The immune system **can/cannot** be helped by vaccination.
- b You are immune to a disease if you **have/do not have** antibodies in your blood.
- c In a vaccination, the microbes that are injected are **dead/live** microbes.
- d Vaccinations should be given **before/after** catching the disease.

8 Draw lines to match these diseases to how they were stopped from spreading.

Disease

The Great Plague started in London in the 17th century. ●

Dr Snow realised that cholera was transmitted through contaminated water. ●

Yellow fever was common in Cuba during the 19th century. ●

How it was stopped from spreading

The people stopped using the drinking water from the contaminated well. ●

The mosquitoes' breeding grounds were destroyed. ●

The villagers of Eyam isolated themselves so that the disease would not be spread. ●

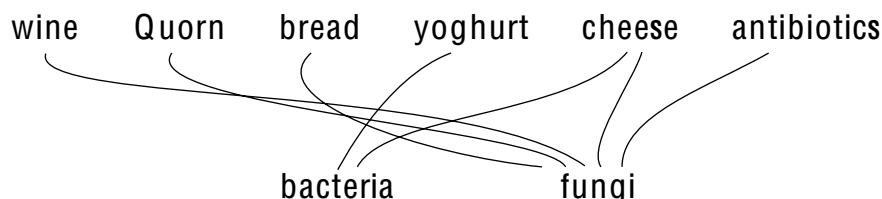
1 Complete these sentences by crossing out the wrong words.

a Viruses are ~~larger~~/smaller than bacteria and are not made of cells.

b ~~Bacteria~~/viruses are single-celled organisms with a cell wall but no nucleus.

c ~~Fungi~~/~~bacteria~~ may be round or made from long threads.

2 Bacteria and fungi have many uses. Draw lines to match each product to the microbe which produces it.



3 Draw lines to match these organisms to their diseases.

Organism

bacteria ●

virus ●

fungi ●

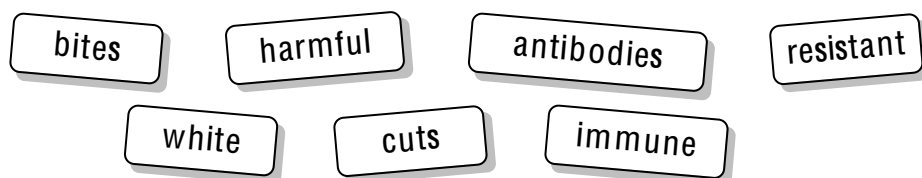
Disease

● athlete's foot

● food poisoning

● flu

4 Complete these sentences by choosing from the words below. You may use words once, more than once or not at all.



a The skin keeps out microbes as long as it has no cuts in it.

b Food and water can contain harmful microbes.

c Animals and insects can spread disease if you get bites from them.

d If microbes get into the blood, they are eaten by white blood cells.

e Some white blood cells make antibodies that help destroy microbes.

f Antibodies recognise and fight microbes, which makes you immune to diseases.

5 Tick the diseases that can sometimes be cured by using an antibiotic.

☐ flu ☒ athlete's foot ☒ tuberculosis ☐ chicken pox

6 Complete the story about penicillin using the words below.

antibiotic

bacteria

cure

penicillin

The first antibiotic was discovered by Sir Alexander Fleming.

He realised that a mould was killing some bacteria on an agar plate. Fleming named the antibiotic penicillin. Later this chemical would be used to cure bacterial infections.

7 Complete the sentences by crossing out the wrong words.

- a The immune system **can/cannot** be helped by vaccination.
- b You are immune to a disease if you **have/do not have** antibodies in your blood.
- c In a vaccination, the microbes that are injected are **dead/live** microbes.
- d Vaccinations should be given **before/after** catching the disease.

8 Draw lines to match these diseases to how they were stopped from spreading.

Disease

How it was stopped from spreading

The Great Plague started in London in the 17th century.

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The people stopped using the drinking water from the contaminated well.

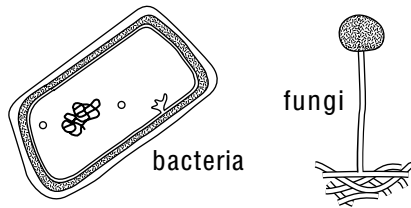
The mosquitoes' breeding grounds were destroyed.

The villagers of Eyam isolated themselves so that the disease would not be spread.

C

Microbes and disease

1 The drawing shows bacteria and fungi.



Write out the two things that are true for both bacteria and fungi:

- They can both be used to make food.
- They both invade other cells, which make millions of copies of them.
- They can both be killed by antibiotics.
- They are both living organisms.

2 marks

2 Some microorganisms are harmful. Others can be very useful.

State which microorganism, **bacteria**, **virus** or **fungi**, is responsible for each of the following.

4 marks

- making bread rise
- causing an attack of the flu
- making the food called Quorn
- causing the disease called tuberculosis

3 a John drew this diagram of the body to show how the body either prevents microbes from entering or destroys them.

He forgot to finish labelling it.
Write each description below with the correct letter.

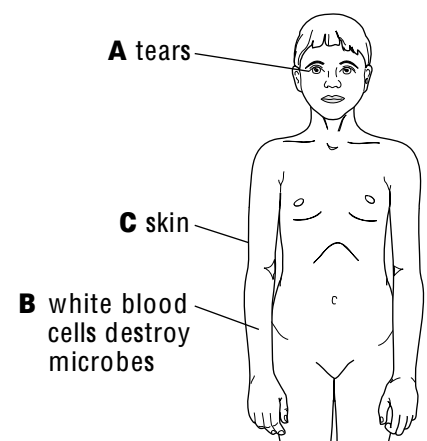
1 mark

acts as a barrier to microbes
wash microbes away

b John was confused by **antibiotics** and **antiseptics**.
Write each word with its correct description.

Kill bacteria outside the body.
Kill bacteria inside the body.

1 mark



Microbes and disease (continued)

- c** John became ill. He wanted to know how the microbes got into his body.

He made a list of how he thought the microbes could have got in.

Which **three** of his ideas do you think were most likely to have been correct?

- A** John shared a drink with another person.
- B** John did not wash his hair for several days.
- C** John forgot to change his socks for several days.
- D** John did not wash his hands after going to the toilet.
- E** John ate some food that had not been cooked properly.

3 marks

- d** John went to his doctor because he thought he had flu. He asked for some antibiotics. Do you think the doctor would give him some?

1 mark

4 Bimla makes some bread.

- a** Explain why she does each of the following steps.
- i** She adds sugar to the yeast before adding the yeast to the dough.
 - ii** She keeps the yeast and dough in a warm place.
 - iii** Once she has added the yeast, she leaves the dough for about one hour.

3 marks

- b** Copy and complete the following word equation to show how the yeast respires when it is first added to the dough.

2 marks

sugar + → water +

- 5 a** To fight some diseases, people can be given a vaccination. What does a vaccination contain?

1 mark

- b** Which part of the body's immune system attacks the microbes causing the disease?

1 mark

- c** From the list, choose one disease which you can be vaccinated against.

1 mark

- A** cough
- B** tuberculosis
- C** flu
- D** athlete's foot

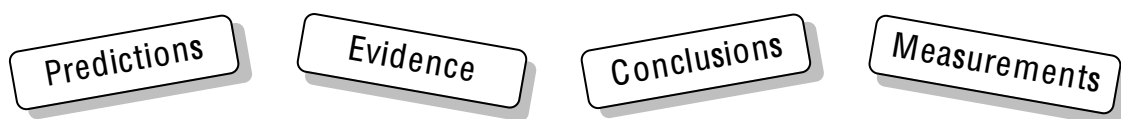
Microbes and disease (continued)

- 6** Many years ago, Lady Montague showed that if some of the pus from a smallpox sore was put into a cut made in the vein of a healthy person, it gave them a small dose of the disease and when they recovered they were immune to the disease.

Seventy-five years later, Edward Jenner noticed that people who had caught cowpox never got smallpox. He tested this by first infecting a boy with cowpox, and later with smallpox. The boy did not suffer from smallpox.

- a** Choose the word that describes what Edward Jenner based his scientific ideas on.

1 mark



- b** How was Jenner's experiment different from Lady Montague's?

1 mark

- c** Lady Montague used smallpox pus as a method of helping to protect against smallpox in 1721, and Edward Jenner first used cowpox pus in 1796. Using this information and information from the graph below, suggest reasons for the pattern of deaths from smallpox:

i from 1631 to 1720

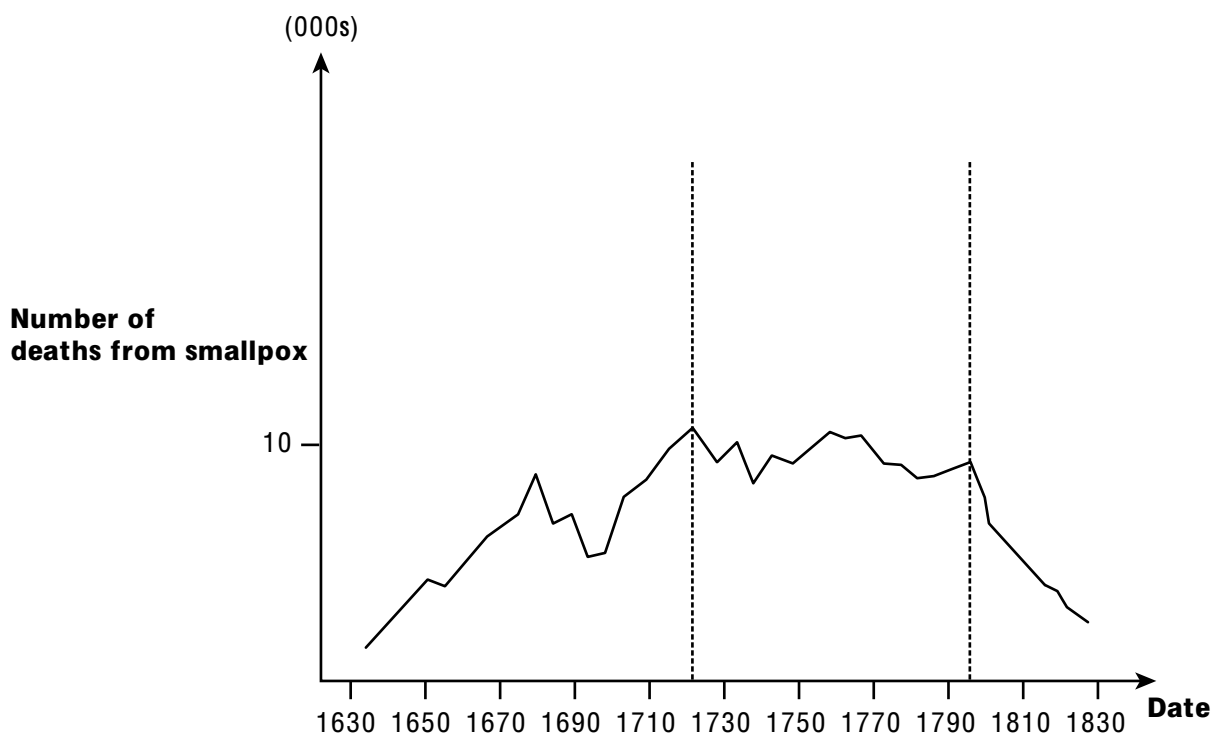
1 mark

ii from 1721 to 1796

1 mark

iii from 1796 to 1831.

1 mark



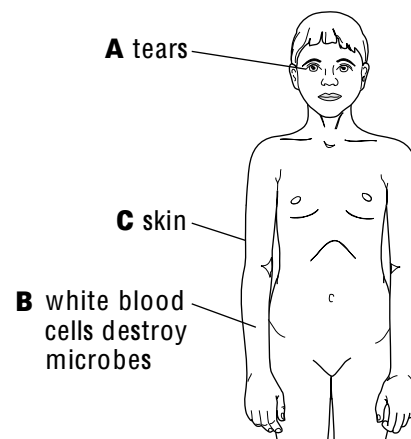
- 1 a John drew this diagram of the body to show how the body either prevents microbes from entering or destroys them.

He forgot to finish labeling it.

Write each description below with the correct letter.

1 mark

acts as a barrier to microbes
wash microbes away



- b John was confused by **antibiotics** and **antiseptics**. Write each word with its correct description.

Kill bacteria outside the body.

Kill bacteria inside the body.

1 mark

- c John became ill. He wanted to know how the microbes got into his body.

He made a list of how he thought the microbes could have got in.

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A John shared a drink with another person.

B John did not wash his hair for several days.

C John forgot to change his socks for several days.

D John did not wash his hands after going to the toilet.

E John ate some food that had not been cooked properly.

3 marks

- d John went to his doctor because he thought he had flu. He asked for some antibiotics. Do you think the doctor would give him some?

1 mark

- e i Why do doctors always tell patients to take all the antibiotic tablets they give them?
ii What might happen to the bacteria over time if antibiotics are not used carefully?

2 marks

Microbes and disease (continued)

2 Bimla makes some bread.

a Explain why she does each of the following steps. 3 marks

- i** She adds sugar to the yeast before adding the yeast to the dough.
- ii** She keeps the yeast and dough in a warm place.
- iii** Once she has added the yeast, she leaves the dough for about one hour.

b Copy and complete the following word equation to show how the yeast respire when it is first added to the dough. 2 marks

sugar + → water +

3 a To fight some diseases, people can be given a vaccination. What does a vaccine contain? 1 mark

b Which part of the body's immune system attacks the microbes causing the disease? 1 mark

c From the list, choose one disease which you can be vaccinated against. 1 mark

A cough

B tuberculosis

C flu

D athlete's foot

4 A disease that is transmitted by mosquitoes is malaria. Scientists think that they are close to producing a vaccine against this disease.

a Describe how such a vaccine may work.

b Why may it be necessary to have booster injections some years later? 2 marks

5 a Babies need protection against diseases even before they are born. How do antibodies from the mother pass to a baby? 1 mark

b Once the baby has been born, how does it get antibodies from its mother? 1 mark

Microbes and disease (continued)

- 6** Many years ago, Lady Montague showed that if some of the pus from a smallpox sore was put into a cut made in the vein of a healthy person, it gave them a small dose of the disease and when they recovered they were immune to the disease.

Seventy-five years later, Edward Jenner noticed that people who had caught cowpox never got smallpox. He tested this by first infecting a boy with cowpox, and later with smallpox. The boy did not suffer from smallpox.

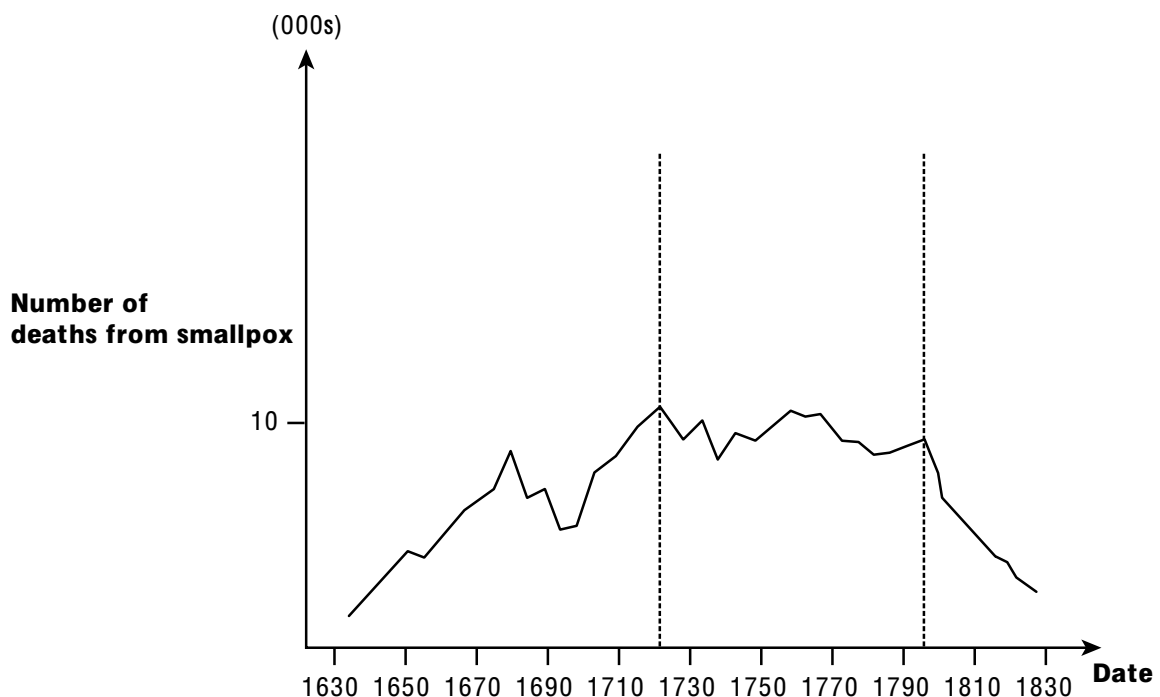
- a** Lady Montague used smallpox pus as a method of helping to protect against smallpox in 1721, and Edward Jenner first used cowpox pus in 1796. Using this information and information from the graph below, suggest reasons for the pattern of deaths from smallpox:

- i** from 1631 to 1720
- ii** from 1721 to 1796
- iii** from 1796 to 1831.

1 mark

1 mark

1 mark



Before Edward Jenner introduced vaccination, smallpox was a major killer of people across the world. Cowpox was completely harmless. Edward Jenner used this information to develop his theory.

- b** What was Edward Jenner's Theory?

1 mark

- c** Why was Lady Montague's method more risky than Jenner's?

1 mark

Question	Answer	Mark	Level
1	They can both be used to make food. They are both living organisms.	1 1	3 3
2 a	Fungi	1	4
b	Virus	1	4
c	Fungi	1	4
d	Bacteria	1	4
3 a	C Acts as a barrier to microbes. A Wash microbes away. (one mark for two correct answers)	1	4
b	Antiseptics kill bacteria outside the body. Antibiotics kill bacteria inside the body. (one mark for two correct answers)	1	4
c	A	1	5
	D	1	5
	E	1	5
d	No	1	5
4 a i	Food for the yeast.	1	5
ii	Yeast needs warmth to grow <i>or</i> reproduce.	1	5
iii	For the bread to rise <i>or</i> for the yeast to respire.	1	5
b	Oxygen	1	6
	Carbon dioxide	1	6
5 a	Weak <i>or</i> dead microbes.	1	5
b	Antibodies <i>or</i> white blood cells.	1	5
c	One from tuberculosis, flu.	1	5
6 a	Evidence	1	4
b	Used cowpox pus instead.	1	4
c i	Smallpox spreading, no cure known.	1	5
ii	Levels off because of the use of cowpox pus.		
iii	Decreasing because of the use of smallpox pus.	1	5

Scores in the range of:	NC Level
4–7	3
8–13	4
14–17	5
18–25	6

Red (NC Tier 4–7)

Question	Answer	Mark	Level
1 a	C Acts as a barrier to microbes. A Wash microbes away. (one mark for two correct answers)	1	4
b	Antiseptics kill bacteria outside the body. Antibiotics kill bacteria inside the body. (one mark for two correct answers)	1	4
c	A	1	5
	D	1	5
	E	1	5
d	No	1	5
e i	So that the microbes are killed, not just weakened.	1	6
ii	They become resistant.	1	6
2 a i	Food for the yeast.	1	5
ii	Yeast needs warmth to grow or reproduce.	1	5
iii	For the bread to rise or for the yeast to respire.	1	5
b	Oxygen	1	6
	Carbon dioxide	1	6
3 a	Weak or dead microbes.	1	5
b	Antibodies or white blood cells.	1	5
c	One from tuberculosis, flu.	1	5
4 a	The vaccine causes the body to produce antibodies against the disease.	1	7
b	Antibodies may not last for a long time.	1	7
5 a	Through the placenta.	1	6
b	In breast milk.	1	6
6 a	Smallpox spreading, no cure known.	1	5
	Levels off because of the use of cowpox pus.	1	5
	Decreasing because of the use of smallpox pus.	1	5
b	That people who had had cowpox would not get smallpox.	1	6
c	Used live smallpox microbes.	1	6

Scores in the range of:	NC Level
4–9	4
10–14	5
15–18	6
19–25	7

Learning outcomes	I can do this very well	I can do this quite well	I need to do more work on this
I can name different kinds of microorganisms.			
I can give some uses of microorganisms.			
I can grow microorganisms safely in a Petri dish.			
I can plan and carry out an investigation into how yeast grows.			
I know what microorganisms can cause common diseases and how they enter the body.			
I can explain how the body defends itself against disease.			
I know how different substances kill bacteria.			
I can explain why doctors should not prescribe antibiotics for the common cold.			
I can explain how the immune system can be helped by vaccination.			
I know how the spread of disease can be controlled.			
I know how correlation is used in testing medicines.			

Word	Definition
active immunity R	A very small living thing that can only be seen with a microscope.
agar plate	Another name for microorganisms.
antibiotic	A unit of measurement $(\mu\text{m}) = \frac{1}{1000} \text{ mm}$. R
antibodies	Unicellular microbes with a cell wall but no nucleus.
antiseptics	Microbes that are smaller than bacteria. They are not made of cells.
antivirals R	Living things that feed on rotting material, for example toadstools.
bacteria	Long microscopic threads in some fungi, such as mould. R
broad-spectrum antibiotics R	Diseases.
control	Organisms that cause disease.
correlation	Diseases that can be caught from sexual intercourse without protection.
double-blind trial R	The body's defences against infection.
epidemic R	A vital part of the immune system, these blood cells help fight against microbes.
fungi (<i>singular</i> fungus)	Special chemicals, produced by white blood cells, which attach themselves to the outside of microbes and kill them.
hyphae R	Protected against infection
immune	Chemicals that kill bacteria.
immune system	A plate containing agar jelly used by scientists to grow bacteria.
immunised	An antibiotic. R
infections	A medicine that kills bacteria but has no effect on viruses.
inoculation R	Antibiotics that kill a wide range of bacteria. R
microbes	Antibiotics that kill a narrow range of bacteria. R
micrometre R	Drugs used to treat diseases caused by viruses. R
microorganism	
narrow-spectrum antibiotics R	
negative correlation	

Word	Definition
passive immunity R	Injected with dead or inactive microbes to make you immune to a disease before you catch it. R
pathogens	
penicillin R	An injection of dead or inactive microbes into your body to make you immune to a disease before you catch it.
placebo	The body produces antibodies against microbes in a vaccination. R
positive correlation	Protected against a disease caused by microbes.
sexually transmitted diseases	Immunity given by an injection of ready-made antibodies into the body. R
vaccinated R	A treatment with microbes to provide immunity against a disease. R
vaccination	A disease that attacks many people at the same time in a community. R
viruses	A link between two or more things.
white blood cells	A second experiment where the variable being investigated in the first experiment is held constant.
	'Medicine' that does not contain any medicine.
	An experiment to discover reactions, e.g. to a drug, where neither the doctors nor the patients know which is the real medicine and which is the placebo. R
	When two variables move in the same direction.
	When two variables move in opposite directions.

active immunity **R**

agar plate

antibiotic

antibodies

antiseptics

antivirals **R**

bacteria

broad-spectrum

antibiotics **R**

control

correlation

double-blind trial **R**epidemic **R**fungi (*singular* fungus)hyphae **R**

immune

immune system

immunised

infections

inoculation **R**

microbes

micrometre **R**

microorganism

narrow-spectrum

antibiotics **R**

negative correlation

passive immunity **R**

pathogens

penicillin **R**

placebo

positive correlation

sexually transmitted
diseasesvaccinated **R**

vaccination

viruses

white blood cells

active immunity **R**

agar plate

antibiotic

antibodies

antiseptics

antivirals **R**

bacteria

broad-spectrum

antibiotics **R**

control

correlation

double-blind trial **R**epidemic **R**fungi (*singular* fungus)hyphae **R**

immune

immune system

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inoculation **R**

microbes

micrometre **R**

microorganism

narrow-spectrum

antibiotics **R**

negative correlation

passive immunity **R**

pathogens

penicillin **R**

placebo

positive correlation

sexually transmitted
diseasesvaccinated **R**

vaccination

viruses

white blood cells

C1 Going on growing

Green

- a Either: they are very small and can only be seen under a microscope, or: they both have a cell wall.
- b Plant cells have a nucleus, bacteria do not.
- c viruses
- d
 - i Any two from: Quorn, beer, wine, bread, blue cheese
 - ii Yoghurt and cheese.
- 1 Bacteria – very small, single celled, cell wall, no nucleus
Viruses – extremely small, not made of cells
Fungi – small, single celled or made of long threads
- 2 Individual answers.

Red

- a They are not made of cells
- b No. Some microbes are useful. Yeast is used to make wine, beer and bread. Quorn is made from fungi. Moulds are used to make cheese. Bacteria are used to make yoghurt and cheese.
- c Warmth, moisture or water, and food.
- 1 Appropriate drawings, similar to those on page 24, in the order virus, bacterium, fungus.
- 2 Tabular form of content of answer **b** above.
- 3 Viruses are smaller than bacteria. They are not made of cells. They do not have a cell wall. Bacteria are larger than viruses. They are made of cells. They do have a cell wall.
- 4 Individual answers.

C2 Defence systems

Green

- a A pathogen is an organism which causes a disease.
- b The skin and tears.
- c Animals carry diseases and can pass them on by biting you.
- d
 - i Antibodies are chemicals produced by white blood cells.
 - ii They kill microbes.
- 1
 - a Microbes on your hands get into the food you touch when eating and will make you ill.
 - b Sneezing produces droplets in the air which can carry microbes in them. If someone breathes in these droplets, they will also be infected by the microbes.
 - c Syringes used by more than one person can carry microbes from the blood of one person into the blood of another.
- 2
 - a Individual answers.
 - b Individual answers.

- c If your immune system has already met a particular microbe, the antibodies can be made more quickly and more easily so that the infection is killed before it has a chance to affect you again.

3 Individual answers.

Red

- a
 - bacteria – Can cause tuberculosis, food poisoning, meningitis and tetanus.
 - fungus – Can cause athlete's foot, ringworm or farmer's lung.
 - viruses – Can cause chickenpox, rabies, colds and flu, German measles, meningitis and AIDS.
- b The skin and tears.
- c Canoeists get wet with water from canals and rivers. If the water contains Weil's disease microbes, the canoeists could get the disease if they didn't wash thoroughly before eating. They could also become infected if some water splashed into their mouths from spray or by their falling into the water.
- d Antibodies can protect your body from one type of microbe. If the virus changes each year, then the antibodies in our bodies will not be able to protect us from the new virus. So we catch colds from different viruses each year.
- 1
 - a Any four from: cuts in the skin, food contains microbes, water contains microbes, air breathed in has microbes, animals or insects biting you, sexual intercourse without protection
 - b Harmful bacteria that get into the body attack body cells and release poisonous chemicals which kill cells and make you feel ill. Viruses force the body's cells to make millions of copies of the virus. They burst and invade other cells and release poisonous chemicals. Fungi grow on the skin and release chemicals that digest skin cells. They can make the skin red and sore.
- 2 White blood cells can work in three different ways. They can engulf microbes and keep them from affecting the body's cells. They can produce antibodies. These are chemicals which can kill the microbes. White blood cells can destroy the toxins produced by the microbes.
- 3 Antibodies can be passed from a mother to her baby in breast milk. Milk from bottle feeding does not contain any antibodies.
- 4
 - a Individual answers.
 - b Individual answers.
 - c The microbe which causes that disease has changed slightly over the years.

C3 Killing bacteria

Green

- a Antiseptics are chemicals that kill bacteria outside our bodies.
- b Penicillin is made from a mould.
- c Whooping cough.
- d Doctors have to examine the patient first to find out if their illness is due to bacteria. Then they can prescribe the correct antibiotic for those bacteria.
- 1 An antiseptic is a chemical that kills bacteria outside our bodies. An antibiotic is a medicine that kills bacteria that have got into our bodies.
- 2 Colds and 'flu are caused by viruses. Antibiotics have no effect on viruses.
- 3 a Lister discovered that antiseptics kill bacteria outside our bodies. This protects people from diseases caused by bacteria.
- b Fleming discovered that antibiotics will kill bacteria inside our bodies. This helps to cure people from illness once bacteria have got into our bodies.

Red

- a To prevent bacteria in sewage from affecting our drinking water.
- b Gowns can be sterilised and made free from bacteria.
- c The antibiotic was formed from a mould.
- d If you don't finish a course of antibiotics, some bacteria will survive, even though you feel better. These bacteria that survive will reproduce again and may become resistant to the antibiotic.
- 1 It is important to try to kill all bacteria that are around us and on things we are likely to touch. Use disinfectants on floors and in sinks and toilets. Use antiperspirants to kill bacteria that cause body odour. Toothpaste kills the bacteria that cause tooth decay.
- 2 a Joseph Lister thought that microbes turned wounds bad after operations. He discovered that carbolic acid would kill microbes on the wounds and instruments used in the operations. This made it safer to have an operation because it stopped wounds becoming infected.
- b Alexander Fleming noticed that mould growing on an agar plate stopped bacteria from growing. He grew more of the mould and found that penicillin extracted from it could kill a number of different bacteria.
- 3 Colds and 'flu are caused by viruses. Antibiotics have no effect on viruses.
- 4 If you don't finish the course of antibiotics, some bacteria will survive, even though you feel better. These bacteria will reproduce again and may become resistant to the antibiotic.

C4 Fighting infection

Green

- a Your body produces antibodies against certain microbes which have been injected into your body.
- b If too much of the microbe was given, the person died.
- c If a person had cowpox, then he would be immune from getting smallpox.
- d James Phipps was the boy whom Jenner tried his theory on. He was the first person to be deliberately vaccinated.
- e No. Health and safety regulations would prevent such an experiment.
- 1 Lady Montague – Introduced to Britain a way of immunising people against smallpox.
James Phipps – Being given cowpox pus and then smallpox pus but did not catch smallpox.
Edward Jenner – Discovering that having cowpox made people immune to smallpox.
- 2 Vaccination is the injection of dead or inactive microbes into one's body so that antibodies will be produced against them.
- 3 Individual answers.
- 4 Individual answers.
- 5 Individual answers.

Red

- a Active immunity results from injection of dead or inactive microbes into the body so that the body produces antibodies against them. Passive immunity results from the direct injection of antibody vaccine into the body.
- b If too many active bacteria were put into the cut, or something went wrong, the person would die.
- c Today our health and safety regulations would prevent such an experiment taking place. No human life should be put at risk for the sake of an experiment.
- d There were many polio outbreaks in the period from 1945 until the late 1950s. Then a polio vaccination programme was introduced and the number of cases reduced dramatically. By the 1970s there were hardly any new cases reported.
- 1 Lady Montague had survived smallpox herself. In Turkey they took some of the pus from a smallpox sore containing live, active bacteria and put it into a cut made in the vein of a healthy person. It gave them a small dose of the disease and then they recovered and were immune to the active microbe. She had her three-year-old son inoculated in Turkey and when she returned to England she persuaded her friends to do the same.

- 2 Individual answers.
- 3 Rubella in a pregnant woman can cause babies to be born blind, deaf or brain damaged.
- 4 These children are susceptible to catching those diseases they have not been immunised against, like measles, mumps and rubella.

C5 The battle goes on

Green

- a By fleas from infected rats biting humans.
- b The people of Eyam stayed in the village. This contained the disease within the village so it didn't spread elsewhere.
- c The infected people are cared for in hospital, isolated from other patients and given antibiotics.
- d The pump in Broad Street.
- e chlorine
- 1 a cholera b Bubonic plague.
- 2 Individual answers.
- 3 Appropriate time line with events marked:
1665 – The great bubonic plague spread through London.
1848 – Dr John Snow identified the source of cholera epidemic in London as bacteria infecting one pump used for drinking water.
1924 – Last bubonic plague outbreak in the United States.
Today – plague controlled by antibiotics; cholera controlled by chlorine in drinking water.

Red

- a The people of Eyam stayed in the village. This contained the disease within the village so it didn't spread elsewhere.
- b The pump in Broad Street.
- c i He found that in the tropics, where yellow fever occurred, there were lots of mosquitoes active all year round.
ii Vaccination and spraying the mosquito breeding sites.
- 1 Rats are infected with bubonic plague. The fleas on the rats are also infected. When the fleas leave a rat and bite humans, they get infected. The disease then spreads from person to person through coughs and sneezes.
- 2 Individual answers.
- 3 People with the disease are isolated in hospital and given antibiotics.
- 4 Appropriate time line with events marked:
1665 – The great bubonic plague spread through London.
1848 – Dr John Snow identified the source of cholera epidemic in London as bacteria infecting one pump used for drinking water.
1924 – Last bubonic plague outbreak in the United States.
Today – plague controlled by antibiotics; cholera controlled by chlorine in drinking water.

- 5 The tropics are always damp and hot. These are ideal conditions for mosquitoes to breed. They can remain active all year round and spread yellow fever from person to person.

C6 Testing medicines

Green

- a To make sure that the medicines won't be harmful to humans.
- b To make sure that the control is a fair test. All the patients have to be treated exactly the same. If they weren't given any medicine they would feel stressed and unhappy.
- c five
- d Positive correlation.
- e The medicine works.
- 1 To check how reliable her results were.
- 2 No. The sample size should be much larger.
- 3 Individual answers.

Red

- a To make sure that the patients who got well did so because of the medicine. Some people might get well without the medicine.
- b It's important to make sure that no one unconsciously influences the results. The placebo control really acts as a fair test this way.
- c Positive correlation.
- d It is an effective medicine.
- e One from: that person had been infected with that type of influenza before and had some antibodies against it in their system, that person wasn't as badly diseased as the others, that person had more natural resistance to the disease, or similar sensible suggestion.

	Treated	Not treated
positive effect	A 2	B 18
no effect	C 18	D 2

- f
- g $(2 + 4) : (18 + 18) = 6:36$
- h Negative correlation.
- i The medicine doesn't work.
- 1 The input variables are the number of people who were given the medicine and the number of people who were given the placebo. The outcome variables are the correlation numbers.
- 2 To check how reliable her previous results were.
- 3 The test on the medicine showed a positive correlation. It was a double-blind trial.
- 4 It showed a negative correlation. It was a double-blind trial.
- 5 No. The sample size should be much larger.
- 6 Individual answers.
- 7 Individual answers.